SCIENCE

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SCIENCE

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NATURAL SCIENCE IN THE HIGH SCHOOL COURSE.

BY R. ELLSWORTH CALL.

THERE is needed no argument to demonstrate the necessity of training in science. It will be assumed that such training is recognized as essential, and that its attainment can in no manner now be dropped from the curricula of the high schools. It is proposed, therefore, to briefly discuss the theme under (1) Comparative Educational Value, (2) Practical Character of the Information Gained, (3) The Tendencies of the Culture of the Day, and (4) Relations to University Requirements.

Comparative Educational Value.

It appears to be a difficult matter to discuss this feature of the proposed theme without the bias that comes either from one's own training or one's taste. Something must be conceded from either standpoint; but concession is difficult and especially so when demanded on the basis of culture value. Rather, then, than on individual opinion must estimation of comparative value be based on culture results. But what constitutes culture? Is it ability to master in ordinary array numerous facts, devise and defend delightful theories, display extended and intimate acquaintance with art, history, or song? Is it held to consist in deep research into lifeless tongues, effete philosophies, degenerate religions? Shall it rest in useful citizenship, productive thought, inventive genius, polished rhetoric, political leadership? These one and all enter into the various conceptions of culture, and these all demand a hearing. Shall they be heard? And how?

I take it that the prime factor in any educational system lies in its power to discipline. The numerous facts which the young person gains during the brief period of four years in the best high schools represent but a very small portion of the sum that marks human attainment. Not the facts, nor their class alone, give the chief feature that is valuable in school life. The collation of facts from observation, their orderly and systematic arrangement, their intelligent discussion, their applicability to the circumstances of the individual by way of amelioration, their power to draw out and direct the best side of the mind, this is discipline. But is not this also applied science? Of such discipline the self is the end. It is not culture for a vocation, for professional training, nor is it culture for an end. It is discipline as a means.

It will be conceded, I presume, that all kinds of culture have not an equally important bearing on every line of activity in life; there is, or should be, occasion for discrimination and choice. Culture, or, if one please, discipline, ought to conform to this natural principle of selection. As a matter of fact and of experience it is found that a student usually accomplishes but little till a definite and settled purpose presides over his movements, or over his intellectual tendencies. The energies of youth are limited, naturally. To save from waste time, which has to a young man quite as much value as effort, practical definiteness should be given to scholastic education. To this end, I believe, that selection of those practical or professional activities, which alone have been deemed most effective in conserving, importing, and transmitting the civilization of any age, should be singled out for school work. In this elective sense, and in this sense alone, every age has taught what it knew and taught all it knew. In former days the physical sciences were not taught because they were not known; they are taught now because they are known. A proper interpretation of the historic facts, therefore, assigns to the physical sciences, in their phenomenal and empirical aspects, a place in the foreground.

As a means of purely mental training I am disposed to accord the first place to physical science. There is involved more than a suggestion of mathematics, more than mere ability to frame correct sentences, more than memoriter exercises respecting isolated facts. Physical science means, if it mean aught, extended application of mathematical data and methods, statement of facts in other than sentential relations, the discovery — whether for the first time it matters not — of underlying laws. . This is culture of the very broadest nature; this means ability to generalize; this constitutes the first stage in a successful intellectual career. I do not believe that one who is abundantly able to develop Sturm's Theorem, trace all the wanderings of the heroes of the Odyssey or the Æneid, outline the journeys of Paul in Asia Minor, or discover meanings in the "Taming of the Shrew," of which its great author never dreamed, can compete in intellectual vigor with the lad able to determine the constitution of a compound substance, decide correctly the affinities of a noxious, stranger plant, or to read facts older than the pyramid of Cheops in a scratched pebble found at the school-house door. The one reads fictions long bereft of true educational value; the other deals with the facts of our daily lives. The one lives and thinks with an ancient, stranger people; the other breathes an atmosphere of intellectual activity and intellectual endeavor. The one deals with symbols — with words as various in significance as are different the minds that use them; the other with laws, unchanging, necessary, logical. The one taught by novelists, dramatists, and poets whose function it is to create imaginary worlds, dwells in an ideal world constructed to suit himself; the other lives in the midst of things of practical accomplishment. It seems to me, therefore, that this difference in the mental aptitudes of students trained side by side, one trained in science, the other in a literature in which even the masterpieces of scientific writing find no place, will stand equally well for the probable values of their influence in after years in determining the current of events.

I would have, then, a still more extended pursuit of physical science in the high school. By this it is not meant that the additional work be in the line of new subjects, but that the time now devoted to *belles lettres* and ancient languages be curtailed; that the time thus gained be given, not to new subjects, but to the more extended prosecution of the few. The point sought to be enforced is that two or three subjects in science, involving observation, technic, and reflection, as botany or physics, zoology or chemistry, be prosecr

very much longer periods. The business of the high school is to train, to develop, to direct, not to give encyclopædic information nor to render the student an intellectual automaton. Its great aim is to awaken thought, not as an end but as a means. Divorce such awakening from the rhetoric of pure philosophy, from the generalities of literature, from the dicta of questionable schemes. Join it to the exact methods involved in scientific research — whether original or in the lines laid down by another matters little; wed it to demonstration of natural law — whether before known is unimportant; weld it indissolubly to those mental processes which involve the most intelligent ratiocination, and the high school curriculum has attained its maximum educational value. But this assumes increased attention to and prosecution of pure science, and in this, we believe, lies the best and greatest educational power.

Practical Character of the Information Gained.

Ten years ago, the English physicist, Professor Sylvanus P. Thompson, wrote the following: "And ought we, then, to be surprised if, in pursuance of the system we have deliberately marked out for the rising generation, we keep our future artisans, till they are fifteen or sixteen, employed at no other work than sitting at a desk to follow, pen in hand, the literary course of studies of our educational code, we discover that, on arriving at that age, they have lost the taste for manual work, and prefer to starve on a threadbare pittance as clerks or bookkeepers rather than gain a livelihood by the less exacting and more remunerative labor of their hands?" True it is that this remark was volunteered in defense of a proposed scheme for technical training — a scheme, the necessity of which is self-evident even in this country, as is witnessed by the establishment of numerous manual training schools. But this does not dull its edge nor blunt its point. The ordinary training in the high school is not suited to the demands of practical living.

It is idle, perhaps, to volunteer the remark that this is a wonderfully practical age and this great West a model of practical life. The conditions that make the environment here are not met by the ordinary scholasticism of the mother East. We can scarce do less, then, than recognize that the high school stands as the expression of the educational needs of a community. Those needs are limited or determined by the multitudinous business interests involved, and, though these be legion, sound economic theory and sound educational science alike demand their recognition in the various schemes of study. Such recognition has not always been accorded, and the small percentage of high school graduates stands somewhat in the attitude of menace to their perpetuity.

The boy or girl who is skilled in the necessary technic of the physical or chemical laboratory has become a most useful member of the community. There are no secrets that are unsearchable, no mysteries intangible, no hopeless intellectual dabbling possible in the laboratory. Principles, system, painstaking manipulation rule therein, and they are necessary. To the one versed only in the arts of literature, the relations and significance of coulombs and atomic weights, of farads and valence, of amperes and reagents, are neither attractive nor necessary. But, if disciplinary value alone be sought, who shall say that intellectual training may not come as truly to him who intelligently uses a galvanometer or a burette as to him who traces his mother-tongue to its ancient stock? And if both are to be measured by manual skill, by ability to devise and to execute, to draught and to realize, who shall say that the student inducted into that truer field of investigation and deduction, implied in the proper pursuit of physical science, has not an immeasurable advantage? He has, at command, a literature limited only by the bounds imposed upon physical research, methods as variant as the students who have trod the paths before him are different, opportunities for usefulness co-extensive with the physical needs or comforts of the highest civilization.

It seems to us that the time given to physical science in the ordinary high school curriculum is far too short to reach the highest practical advantages. Usually such curricula encompass the whole round of scientific endeavor. A few weeks to this, somebody's "fourteen weeks" to that, and a term to a third subject — these often without logical sequence — and the boy or girl goes forth trained in science. Did I say trained? Forsooth, the first principles have not been mastered, the technic is entirely unknown. Add to this the positive, and, it will be granted, unfortunate fact that science subjects are taught by persons themselves untaught in either the matter or spirit of science, still less the method, and the cause of comparative failure is at hand. We say comparative failure, and use the term advisedly. We use it, because never less than a year is devoted to algebra, often more, usually an equal period to geometry, and the lion's share of the time is given to language work. All the disciplinary power possible is thus given to these subjects, and those who teach them recognize that time, and time alone, is productive of fruitful results. One, who in the face of such educational fadism, would dare suggest two years of botany or of zoology, three or four years of chemistry or of physics, would surely, like Paul, be thought "beside himself." And yet this is exactly the position we seek to defend. It will be conceded, we imagine, that science has disciplinary value, that its prosecution develops a most desirable phase of mental life, that in its exacting and painstaking methods it stands without a peer; it will also be granted that among those who have traversed its inviting fields, thought and written on what they have seen and felt, there are very many who have enriched, immeasurably, the literature of their several lands; in short, it must be granted, it seems to us, that no phase of human thought exists which can be valuable for training in the high school that does not find an equally valuable counterpart in the sphere of science. The multitude of ways in which such knowledge and training may enter into every-day life, in every social condition, renders the argument of practical utility unanswerable.

The radical feature in science training lies in the assumption that even elementary education should "supply that exact and solid study of some portion of inductive knowledge," which Dr. Whewell long ago pointed out as a want in educational method. Through it education "escapes from the thralldom and illusion which reign in the world of mere words." The student's own examination and investigation of phenomena, his own conception of their relations and values, his own inferences concerning the laws he supposes to underlie the surface of things, these all constitute the practical side of his education. In this sense, it seems to us, physical science possesses a paramount value, and should be placed accordingly in a wisely adjusted scheme for study.

The Tendencies of the Culture of the Day.

Educational systems and schemes reflect, it will be conceded, the culture tendencies prevalent during their inaugural. It cannot, however, be assumed that their arrangement has always been best, or that it has always fallen into the wisest and safest hands. The fault

lies, not in the system, perhaps, which may be good enough considered as an end, but in the personal training of those who have had these systems in charge. I think it true that educational methods and dicta are among the very last, if we except theology, to yield to the demands imposed by changing environment. To one cultured along the lines fashionable a decade ago, it becomes a difficult task to change methods and opinions that are the outgrowth of such discipline. The maintenance of courses of study that are either largely classical or mathematical means simply a system based upon methods in vogue long since. A compromise is noted, however, in those schools in which a so-called "scientific course" is provided; from this concessisn it is easy to pass to those schools whose work is largely along the lines imposed by physical science.

This modification — whether it be forced or natural is immaterial — reflects the tendencies of the thought of the day. On all sides, and in all manner of ways, increased attention is being given to physical science. The reason is not past finding out — it lies close at hand. Science enters into the home, social and mercantile life of the world to a degree never before known in the history of mind. It has builded upon a foundation broadly and well laid, because laid primarily with a just appreciation of the physical necessities of man. Those who now toil, and no longer with unrequited labor, in the laboratories of the world have felt and still feel the impetus due to the appreciation. Not a law of life, not a condition in the physical environment of men, not a pest that may destroy his stores or his comfort, not a product of land, sea or air, but somewhere some one is busy working out details, deducing laws, formulating results, suggesting utilities. The world is *en rapport* with works of this sort, and it is by no means uninformed as to their value. A new law of light, a new application of electric force, a new fact in chemistry, a new method of locomotion, these all are heralded as to an expectant community. The world waits for facts such us these, the world expects them.

The question turns now on the manner in, and the extent to which this tendency is to be recognized in the high school curriculum. It does not need a prophet's vision, nor a sage's wisdom to give the answer. It will be answered on the lines that have reference to the circumstances, duties, and work of life. It were idle to stem the tide even were it desirable. It is not a counter-argument that the term "practical tendency" is accepted at its narrowest meaning—that of bare and specific preparation for professional or business pursuits. But if even such illogical answers should be made, the fact still remains that the high school is the poor man's college. It furnishes the highest education which the major portion of the young men and women of a community can obtain. Who, then, shall say that it should not prepare, not alone for right living, which is solely a subordinate and moral aspect of the question, but for successful business living? Why should not the studies pursued have discipline as a means and utility as an end? We do not believe a thoughtful, intelligent answer can be negative. We ask, then, a modification of the traditional curriculum and the institution — better perhaps to say substitution — of one which has as a prominent feature the culture of today. The time has passed when one ignorant of the laws of health and the gross anatomy of the person, ignorant of the chemistry of cookery and the laws of ventillation, ignorant of the dynamics of physical nature and unlearned as well as unskilled in the manipulations of the laboratory, may pose as a cultured man, though his knowledge of wonderful tongues and skill in rhetorical or literary art be never so great. "What can you do?" not "what do you know?" is the question of the hour, and the high school of to-day and of the future will be compelled to answer the question. Will it do it completely? Not as at present constituted, nor, if like the barrister, it be bound by the law of precedents, will it ever intelligently answer it.

Relation to University Requirements.

To this phase of the subject attention will be but briefly directed. The high school does not exist for the college or the university; it is an end in itself. Its original institution did not contemplate its relations to these institutions as a gymnasium, but appears to have resulted from the more universal methods of gradation of school work. In cities it was learned that the time required to master the elementary studies could be much shortened by rigid system and rigid enforcement of its necessary provisions. Following this it was discovered that students might complete their school life at too early an age. Additional studies were introduced, and finally a system involving a secondary education, formerly confined to private academies and seminaries, became a part of the public school scheme; the high school became a fact.

There can be no question that popular education did not contemplate the establishment of the high school. To many, and to us, its legal right to exist is questionable. However that may be, the high school has come to stay. It has the support and sympathy of the liberally educated classes, and is not unappreciated by the less fortunate grades in society. So that the problem of its curriculum must be worked out in view of the interest these two classes of society evidence in general education.

At the end of the scheme of public instruction stands the university. Most, if not all, of the States recognize this relationship, and the curriculum of the secondary or high school is devised to conform to it. We think wisely. Recently, in this city, DesMoines, a convention of schoolmasters discussed this, or a nearly related matter, and the opinion at that time expressed evidenced a condition of belief far from unanimity as to the requirements presented by the university authorities. But the university is right in high requirements; right in insisting that secondary instruction be confined to secondary schools; right in assuming that its educational forces are to be exerted along the highest possible lines. Particularly is this true of the requirements in physical science. The proper prosecution of original research, which is certainly a university prerogative, the best presentment of modern scientific thought and method, which is the aim of university education, cannot be realized when its instructors are burdened with quasi-elementary work. So, back upon the high school must fall the work of elementary instruction in physical science. This the university demands, and this the high school must do. Now, in the appointment of the various courses leading to degrees in the universities, it is noticeable, if decade he compared with decade, that more and more are scientific subjects occupying the fore-ground. More time to science, fewer subjects; more stringent requirements, greater opportunity for elections, these are the rule in the modern university and these must be understood and appreciated on the part of the high school. There are few good colleges and no universities of standing which do not now demand at least a year in physics and a year of botany. In most others biological subjects are held as essential, and not a few require a fairly

complete course in physical geography — of all high school subjects the most difficult and the one most commonly poorly taught. Certain universities, as Harvard and Michigan, require elementary chemistry; others entirely omit it, because in it students are too often poorly prepared. Said a university professor of chemistry to me, not long ago, "I prefer my students to come to me with no chemistry. I find they too often come with matter and methods to be unlearned." Now, this must be remedied in the chemistry work of the high school; the "indictment must be quashed;" the fault must be corrected by proper instructions and skilled methods. Without appliances, that is to say, without laboratory facilities, radical and valuable revolution is impossible. Physical science in the high school must be experimental.

Without multiplying words, then, it may be stated that the high school must give, to those who ask it, preparation for entrance into university work. It must adapt its science curriculum to the requirements of the standard college or university. For long years these higher institutions compelled certain and definite work in language and mathematics, they compel that work, with little or no modification to-day. Why cannot they, equally well, compel proper science preparation? We believe they can; we think they will.

There will not be, in the nature of things there cannot be, a set limit to science requirements in the universities. As the tables of the various laboratories, physical, chemical, physiological and biological, become over-taxed, up go the requirements. The standards of entrance are being steadily raised, especially in Indiana University, Michigan University, Cornell, Yale, Harvard, and Leland Stanford, Jr., Universities, as fast as the high and other secondary schools will admit of it. So there is no goal; no end; the high school will ever need to keep close watch on university matters and determine its own work accordingly. Our own State university proposes to the high school to occupy advanced ground in this very matter; to gain and hold the confidence of the university, on the one hand, to meet a legitimate demand for more complete preparation in science on the other, the high school course must be materially modified.

THE FEEDING OF HORSES.

BULLETIN No. 13 of the Agricultural Experiment Station of Utah has been received. This bulletin reports the results of a feeding trial of horses by the director, J. W. Sanborn. It reports the result of a trial in a direction that the American Experiment Station literature is almost silent upon, viz., feeding horses hay and grain mixed, and feeding cut against whole hay to horses.

It is a common belief with horsemen that when grain, especially meal, and more especially such meal as corn meal, is fed to horses alone or mixed with hay, it tends to compact in the stomach and produce indigestion. It is believed that it so far compacts that the gastric juices do not have free access to the mass of it. Furthermore, it is believed to be subject more to the washing influence of heavy drinking. In the latter respect it is known that the horse's stomach is very small, and that grain is liable to be washed out of it, as the stomach necessarily overflows with water.

As usual, the writer fed two lots of horses for nearly three months, one lot with hay and grain mixed, and the other lot with hay and grain fed separately. At the end of this period the food was reversed, and the horses were fed some two months more. It would be unnecessary to quote the figures of lengthy trial. Suffice it to say that it was found that horses, as in the case of cattle and pigs, showed no disadvantage by the division of the grain and hay into separate feeds over feeding hay mixed with grain. Indeed, in this trial he found a disadvantage for the horses on the hay and grain mixed, they not maintaining their weight as well. The author ascribed this result to the fact that the timothy hay when cut fine, with its sharp solid ends, irritated and made sore the mouths of the horses, and possibly induced too rapid eating, as when the hay and grain were moist they would be more likely to eat more rapidly than when fed dry. As this trial is in accord with trials with ruminants and with the pig, it would seem quite probable that the old and persistent argument in favor of mixing hay and grain is not sound.

The second trial reported in this bulletin covered feeding of cut against whole hay to horses. This trial also covered two periods in which the foods were reversed with the sets, in order to determine whether any change of weights found was due to the individualism of the horses, or whether it was due to the system of feeding. The two periods covered from August 10 to December 31. As in the other case, we will not review the tabulated data that accompany the bulletin. This trial was very decisively in favor of the cut clover for the four months and a half covered by this period. The food fed was clover, and the author points out the fact that clover hay and lucerne, unlike timothy hay, do not present sharp, solid, cutting edges. The results are decisive, and in accordance with those of a trial made by the Indiana Experiment Station with cattle. Director Sanborn points out the fact that these trials, covering nearly a year's time with four horses, showed that horses consume practically the same amount of food that cattle do when high fed, and make it somewhat clear that horses make as economical use of hay and grain as do cattle, and he calls attention to the fact that the practice of charging more for pasturage of horses, where grooming is not involved, is not well founded. He also shows that less food was eaten during the hot months than during the cooler months, and particularly that the horses ate less grain during the hot months than during the cooler months. The trial seems to show also that a rather large ration of grain for work-horses is an economical one.

NOTES AND NEWS.

THE idea of flower-farming for perfumes seems to be exciting a good deal of interest in New South Wales, as many inquiries on the subject have lately been submitted to the Agricultural Department. There are at present in the colony no means of illustrating the practical operations of this industry, but the *Agricultural Gazette of New South Wales* hopes that this deficiency will soon be supplied by the institution of experimental plots on one or more of the experimental farms. The *Gazette* points out that in scent farms large quantities of waste material from nurseries, gardens, orchards, and ordinary farms might be profitably utilized, while occupation would be found for some who are unfit for hard, manual labor. A Government perfume farm was lately established at Dunolly, in Victoria, and this promises to be remarkably successful.

— At the meeting of the Field Naturalists' Club of Victoria on March 14, as we learn from *Nature*, Professor Baldwin Spencer, the president, gave an interesting account of a trip he had made to Queensland in search of Ceratodus. Special interest attaches to this form, since it is the Australian representative of a small group of animals (the Dipnoi) which is intermediate between the fishes and the amphibia. Ceratodus has its home in the Mary and Burnett Rivers in Queensland, whilst its ally, Lepidosiren, is found in the Amazon, and another relative, Protopterus, flourishes

in the waters of tropical Africa. Although unsuccessful in obtaining the eggs of Ceratodus, owing to the early season, Professor Spencer was able, from a careful study of the surroundings under which the animal lives, to infer that its lung is of as great a service to it during the wet as during the dry season — a theory in direct opposition to the generally accepted one that the lung functions principally during the dry season, when the animal is inhabiting a mud-cocoon within the dry bed of the river.

— A second attempt is to be made to build an observatory at the top of Mont Blanc. As the workmen who tunnelled last year through the snow just below the summit did not come upon rock, M. Janssen has decided that the building shall be erected on the frozen snow. A wooden cabin was put up, as an experiment, at the end of last summer, and in January and early in the spring it was found that no movement had occurred. According to the Lucerne correspondent of the London *Times*, the observatory is to be a wooden building 8 metres long and 4 metres wide, and consisting of two floors, each with two rooms. The lower floor, which is to be embedded in the snow, will be placed at the disposition of climbers and guides, and the upper floor reserved for the purposes of the observatory. The roof, which is to be almost flat, will be furnished with a balustrade, running round it, together with a cupola for observations. The whole building will rest upon six powerful screw-jacks, so that the equilibrium may be restored if there be any displacement of the snow foundations. The building is now being made in Paris, and will shortly be brought in sections to Chamounix. The transport of the building from Chamounix to the summit of Mont Blanc and its erection there have been intrusted to the charge of two capable guides — Frederick Payot and Jules Bossonay.

— Dr. J. Hann laid before the Academy of Sciences at Vienna, on May 5, says *Nature*, another of those elaborate investigations for which he is so well known, entitled "Further Researches into the Daily Oscillations of the Barometer." The first section of the work deals with a thorough analysis of the barometric oscillations on mountain summits and in valleys, for different seasons, for which he has calculated the daily harmonic constituents, and given a full description of the phenomena, showing how the amplitude of the single daily oscillation first decreases with increasing altitude, and then increases again with a higher elevation. The epochs of the phases are reversed at about 6,000 feet above sea-level as compared with those on the plains. The minimum on the summits occurs about 6 A.M., and in the valleys between 3 and 4 P.M. The double daily oscillation shows, in relation to its amplitude on the summits, nearly the normal decrease, in proportion to the decreasing pressure, but the epochs of the phases exhibit a retardation on the summits, of as much as one or two hours. In the tropics, however, this retardation is very small. He then endeavors to show that these modifications of the daily barometric range on mountain summits are generally explained by the differences of temperature in the lower strata of air. In connection with this part of the subject, he considers that even the differences in the daily oscillations at Greenwich and Kew are mostly explained by the different altitudes of the two stations and by the fact that Greenwich is on an open hill. In the second section he has computed the harmonic constants for a large number of stations not contained in his former treatise of a similar nature, including some valuable observations supplied by the Brazilian Telegraph Administration, and others at various remote parts of the globe.

— The last meeting of the Royal Meteorological Society for the present session was held on Wednesday evening, June 15. A paper on "English Climatology, 1881–1890" was read by Mr. F. C. Bayard. This is a discussion of the results of the climatological observations made at the society's stations, and printed in the *Meteorological Record* for the ten years, 1881–1890. The instruments at these stations have all been verified, and are exposed under similar conditions, the thermometers being mounted in a Stevenson screen, with their bulbs four feet above the ground. The stations are regularly inspected and the instruments tested by the assistant secretary. The stations now number about eighty, but there were only fifty-two which had complete results for the ten years in question. The author has discussed the results from these stations and given the monthly and yearly means of temperature, humidity, cloud, and rainfall. His general conclusions are: (1) With respect to mean temperature the sea-coast stations are warm in winter and cool in summer, whilst the inland stations are cold in summer and hot in winter. (2) At all stations the maximum temperature occurs in July or August, and the minimum in December or January. (3) Relative humidity is lowest at the sea-coast stations and highest at the inland ones. (4) The south-western district seems the most cloudy in winter, spring, and autumn, and the southern district the least cloudy in the summer months, and the sea-coast stations are, as a rule, less cloudy than the inland ones. (5) Rainfall is smallest in April, and, as a rule, greatest in November, and it increases from east to west. "The Mean Temperature of the air on each day of the year at the Royal Observatory, Greenwich, on the average of the fifty years, 1841 to 1890" was presented by Mr. W. Ellis, F.R.A.S. The values given in this paper are derived from eye observations from 1841 to 1848, and from the photographic records from 1849 to 1890. The mean annual temperature is 49.5°. The lowest winter temperature, 37.2°, occurs on January 12, and the highest summer temperature, 63.8°, on July 15. The average temperature of the year is reached in spring on May 2, and in autumn on October 18. The interval during which the temperature is above the average is 169 days, the interval during which it is below the average being 196 days.

— The Todas, inhabiting the Nilgiri plateau, says *Nature*, are not dying out gradually, as has long been supposed. The last census figures show that they have increased by no less than 10 per cent during the last ten years, there being now nearly eight hundred of them altogether.

— In a recent number of the Journal of the Straits Branch of the Royal Asiatic Society there is an interesting note on the little insectivora, *Tupaia javanensis*. It is very common in Singapore, and especially in the Botanic Gardens, where it may be often seen running about among the trees. It is easily mistaken for the common little squirrel (*Sciurus hippurus*), of which it has much the appearance. When alarmed it quickly darts up the trunk of the nearest tree, but it is a poor climber, and never seems to go high up like the squirrel. Besides these points of resemblance, it appears to be largely frugivorous. It was found that the seeds sown in boxes were constantly being dug up and devoured by some animal, and traps baited with pieces of cocoa-nut or banana were set, and a number of tupaias were caught. These being put into a cage appear to live very comfortably upon bananas, pine-apple, rice, and other such things; refusing meat. The Rev. T. G. Wood, in his "Natural History," states that *T. ferruginea* is said to feed on beetles, but to vary its diet with certain fruits. The common species at Singapore seems to be almost entirely frugivorous, though its teeth are those of a typical insectivora.

— The Mississippi Valley Medical Association will hold its eighteenth annual session at Cincinnati, Oct. 12–14, 1892. An excellent programme, containing the best names in the valley and covering the entire field of medicine, will be presented. An address on Surgery will be delivered by Dr. Hunter McGuire of Richmond, Va., President of the American Medical Association. An address on Medicine will be made by Dr. Hobart Amory Hare, Professor of Therapeutics and Clinical Medicine, Jefferson Medical College, Philadelphia. The social as well as the scientific part of the meeting will be of the highest order. The Mississippi Valley Medical Association possesses one great advantage over similar bodies, in that its organic law is such that nothing can be discussed during the sessions save and except science. All ethical matters are referred, together with all extraordinary business, to appropriate committees — their decisions are final and are accepted without discussion. The constitution and by-laws are comprehensive and at the same time simple. Precious time is not allowed the demagogue or the medical legislator. The officers of the Pan-American Medical Congress will hold a conference at the same time and place. E. S. McKee, M.D., Cincinnati, is the secretary.

SCIENCE:

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THE DE LAINCEL FUND FOR THE STUDY OF THE MAYA LANGUAGE AND ITS GRAPHIC SYSTEM.

BY WM. M. AUGNEY.

THE de Laincel Fund, so-named, after a relative, by a gentleman of Philadelphia, now residing in Mexico, who contributes handsomely to its support, has for its object a thorough study of the graphic system of the ancient Mayas, by collecting vocabularies of that language and its dialects, and obtaining reliable artistic reproductions, by means of photographs, of the ancient cities and mural inscriptions of Central America, also photographing and copying ancient manuscripts or other material which will be of service to students in this special field of research.

The work will be carried on under the direction of an advisory committee, to be chosen from among ethnologists who are authorities upon, and students of, the Maya language, its paleography and art.

The exploration of the fund will be carried on under the direction of Dr. Hilborne T. Cresson of Philadelphia, well known as an ethnologist in America and Europe. The result of his researches have at times been published by the Peabody Museum, where for the past five years he has been a special assistant, working under the direction of Professor F. W. Putnam of Harvard University. Dr. Cresson's artistic training at the Ecole des Beaux Arts, in the ateliers of the sculptor Alexander Dumont, and the painter J. Leon Gerome (his works having been exposed in the Salon of 1877), joined to that of an accomplished French and Spanish scholar, especially capacitates him for this line of research. He has also for some years past been studying the Maya language under the direction of so distinguished an authority as Professor Daniel G. Brinton, and a good basis has thus been obtained for future research.

The de Laincel Fund will act in conjunction with some of our leading American institutions, yet to be determined upon, or independently, as its patron may deem best. The work will be carried on during the healthy season in the *south*, adopting the plan already pursued by other exploring parties — that of carrying out its investigations during those months which are best suited to the sanitary condition of its workers.

Secretary's office, 519 Spruce Street, Philadelphia, June 27.

CURRENT NOTES ON ANTHROPOLOGY. — IX.

[Edited by D. G. Brinton, M.D., LL.D.]

The Peruvian Languages

Now that the great work of Dr. E. W. Middendorf on the Peruvian languages has been brought to a conclusion by the publication of the sixth and last volume, that on the Muchik (or Chimu or Yunca) tongue, the high value of this contribution to American ethnology should be urged on the scientific world.

Dr. Middendorf is a medical man who practised his profession many years ago in various parts of Peru, making a study of the native dialects his favorite recreation. He thus became practically familiar with them as living tongues, and backed up that knowledge by an acquaintance with such literature as they possessed. The results of this long devotion are now before us in six large octavo volumes, published by Brockhaus, Leipzig, and counting up in all to nearly 2,400 pages of handsomely printed material. The languages considered are the Kechua, the Aymara, and the Chimu, with an appendix on the Chibcha. There is an ample supply of grammatical analyses, texts, phrases, and, of the Kechua, a copius Kechua-German-Spanish dictionary. That the Aymara and Chimu vocabularies are not arranged alphabetically must be regarded as a blemish. One of the volumes contains the original text and a German translation of the drama of Ollanta, believed by many to be a genuine specimen of a native, pre-Columbian, dramatic production. There are also many songs and specimens of prose writings in the same tongue. Taking Middendorf's practical observations along with Tschudi's "Organismus der Kechua Sprache," the student will find himself well equipped to master this interesting idiom.

The Orientation of Primitive Structures.

The study of the relative directions which the walls and angles of ancient structures bear to the cardinal points has scarcely yet received the attention from archæologists which it merits.

Several varieties of this "orientation," as it is termed, are to be found, each with its own meaning. The ancient Egyptian *mastabas* and pyramids have their sides facing the cardinal points. This arose from the desire of having the door in the centre of the eastern side to face the rising sun, and the western door, *sta*, to face the setting sun, as it was through the latter that the god Anubis conducted the soul to the other world. On the other hand, the Babylonians and Assyrians directed the angles, and not the sides, of their temples to the cardinal points, for what occult reason is not clear. Again, Mr. J. Walter Fewkes has found that the *kib vas*, or sacred chambers, of the Tusayan Indians at the Moqui Pueblo are oriented north-east and south-west. This he at first thought was owing to the character of the bluff, but there are reasons to believe it of a ceremonial origin.

Some curious observations in this connection are reported by Mr. Robert M. Swan, about the Zimbabwe ruins, in the last number of the *Journal of the Royal Geographical Society*. He found a series of ornaments on the walls of the great temple so disposed that one group would receive directly the sun's rays at his rising and another at his setting at the period of the winter solstice, when these points in that

latitude were respectively 25° south of east and west; while a third series of ornaments faced the full midday sun. Others were similarly arranged for the summer solstice; and a great stone over the temple showed, by alignment with the main altar and a carved pattern on the wall, the true north and south.

Last year an English archæologist undertook a journey to Greece to make a special study of the orientation of the ancient temples on that classic ground, but his results have not yet appeared. Certainly, as will be seen from the above, the point is one full of significance.

On Prosopology.

There is little doubt that craniology, as a branch of anthropology, has been much over-estimated, and affords only very insecure material for ethnic classifications. On the other hand, the study of the features of the face, which may be called Prosopology, from the Greek, *prosopon*, face, is yielding constantly more valuable results. The width or narrowness of the face, the nasal and orbital indices, the prominence of the jaws, the facial angles, and the development of the chin, all are points of prime ethnic significance.

One of the leading European writers on this subject is Professor Kohlman of Basel, whose works are extremely instructive. In this country a series of papers on "The Ethnology of the Face," by Dr. A. H. Thompson, have appeared in the *Dental Cosmos* for the current year. They place the details of the subject in a popular light, and emphasize its value; but they would be more satisfactory had their author not been led astray by some of the books which he quotes. To class the Eskimos and the American Indians among the Mongolians is quite out of date; and to call the white race Caucasians, and to divide them into blondes and brunettes as leading subdivisions is scarcely less so. He does, indeed, distinguish an "Americanoid" type, from which he excludes the Eskimos and Aleuts as being "true Mongols;" on what grounds he or any one would be puzzled to say. He describes the hair of this "Americanoid" type as similar to that of the Mongolians, from which, in fact, it differs in nearly every respect. In spite of these drawbacks, Dr. Thompson's articles form a welcome and praiseworthy addition to recent American contributions to anthropologic literature.

Linguistic Bibliography.

The study of American languages will in the future be vastly facilitated by the admirable series of bibliographies by Mr. James C. Pilling, which are now being published by the Bureau of Ethnology. Some idea of their thoroughness may be gained from the fact that the latest issued, confined to the Algonquian dialects alone, has 614 double-columned, closely printed, large octavo pages! Compare this with the 258 pages of Ludewig's "Bibliography of American Aboriginal Literature," which included all the languages of both North and South America!

Mr. Pilling has put forth similar volumes, less in size but not inferior in completeness, on the Iroquois, Eskimo, Dakota and Muskokee groups of tongues; and proposes to lay a similar basis for the study of all the North American stocks. It would be most desirable for some similar catalogue to be made relating to the tongues of South America.

The Decrease of the Birth-rate.

One of the most portentous problems is the decrease of the birth-rate in certain social conditions. It is asserted on apparently good authority that the Negritos and the Polynesians are dying out, largely owing to the infertility of their marriages. Certain South American tribes, the Guatos of Paraguay, for instance, will soon disappear from the same cause. But we need not confine our instances to savage peoples. Physicians say that our "colonial dames," scions of Anglo-American families who have lived several generations in this country, have much smaller families than their great-grandmothers.

In France this lessening of the birth rate has assumed serious proportions, and has alarmed patriotic men lest as a nation it should become numerically too weak to hold its own in the conflicts of the future. The distinguished author and statesman, the Marquis de Nadaillac, has published some stirring admonitions to his countrymen on the subject under the titles "Le Peril National and la Depopulation de la France." He finds the birth-rate least in the cities, in the richest communes, and in the most prosperous conditions of society. Turning to its causes, he has convinced himself that this diminution is voluntary and of malice prepense on the part of married couples. They do not want the bother of many children; they do not wish their property to be split up; they prefer pleasure and ease to the labor of parental duties. Young men prefer mistresses to wives, and mistresses are always barren. The competition of modern life and its rabid thirst for enjoyment undermine the family tie. The birth-rate is small, not for physiological but for sociological reasons. How far this applies to the United States has not yet been sufficiently investigated; but it is probably nearly equally true here.

THE VARIABILITY OF SPECIFIC CHARACTERS AS EXHIBITED BY THE EXTINCT GENUS CORYPHODON.

BY CHARLES EARLE.

IT is a well-recognized law in biology, that a species or a genus upon the point of extinction undergoes a great amount of variation; and, as an example of this kind, I propose to describe some of the variations which the species of the fossil genus *Coryphodon* exhibit.

The fine collection of Coryphodon material in the American Museum of Natural History has enabled me to study this subject; and in a forthcoming paper in the Bulletin of the Museum I shall attempt a revision of the American species of *Coryphodon*.

The great amount of variation in this genus is shown from the fact that no less than twenty-one species have been described, and only in a few cases have any of them been acknowledged as synonyms.

Taking up the variation of the teeth, I will first describe the structure of a typical upper and lower molar of *Coryphodon*. The superior molars are a modification of the primitive tri-tubercular type, in which the anterior crescent, or antero-external lobe, has been lost, or so much modified that only traces of it remain. On the antero external portion of the crown there is a prominent cone, which is in connection with the single internal lobe by a sharp crest (see Fig. *a*, *c*); this forms the main grinding surface of the tooth. On the second superior molar of a true Coryphodon there is always a well-developed postero-external crescent (see Fig. *e*, *c*), which is homologous with the postero external crescent of other forms. This crescent may undergo a great amount of variation, as will be described later. In the last superior molar the postero-external crescent is represented by only a crest, which runs parallel, or nearly so,

with the anterior crest already described. As in all the early Eocene-Tertiary Mammalia, the pumolars of both the lower and upper series are much simpler than the true molars. The structure of the lower molars of *Coryphodon* is interesting, as it represents a stage in the modification of a more primitive type, which had the enamel arranged in the form of two symmetrical V's or crescents. Now in *Coryphodon* the anterior limb of each crescent is nearly reduced; this applies especially to the posterior V. The portion of the tooth bearing the anterior V is raised high above the posterior or heel part.

The variation in size of the teeth of the different species of *Coryphodon* is very great, and in not a single instance have I been able to find two individuals, of the same species, whose teeth are of the same size. This variation is shown in the form of the canines and incisor teeth; in the former the difference in size is largely due to age and sex.

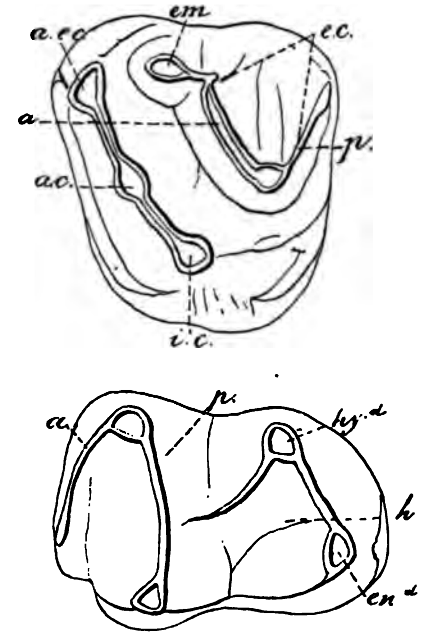
The last upper molar undergoes a great amount of variation, it varying from the nearly quadrate form to that of an elongated oval, the latter form occurring in the more modified species. The modification of the elements of the crown of the second superior molar is interesting, as we can trace in this transformation a true phyletic series, from the less specialized to the more modified species. The typical forms of *Coryphodon* have the external crescent of this tooth well developed. The first step towards reduction of the crescent occurs where the intermediate portion of the posterior limb (see upper Fig. *p*) disappears, leaving an external isolated cusp (*C. testis*). This condition is found permanent on the last superior molar of *Ectacodon*, the latter genus not having advanced so far in its dental evolution as *Coryphodon*. The species *C. elephantopus* represents an intermediate stage in its dental evolution between that of *Coryphodon testis* and *Ectacodon*.

Professor Cope established the genus *Metalophodon* upon the character of the crescent of the second superior molar, and in this genus the posterior limb of the crescent is nearly reduced. As all stages exist in which this crescent is well developed down to that where it is wanting, I can not accept Metalophodon as a good genus, and believe it should be considered a synonym of *Coryphodon*. The most modified condition of this crescent is where it is reduced to merely the anterior limb. The latter stage is permanent in the last upper molar of all the known species of *Coryphodon;* but it is interesting to note that in a genus described by Cope, called *Manteodon*, the last upper molar has a perfectly formed external crescent.

The genus *Manteodon* differs from all other genera of the *Coryphodontidæ* from the fact that the last upper molar has two well-developed internal cones. Now in all other forms of this family the postero-internal cone (*hypocone*) is wanting, although traces of it occur in *C. elephantopus*.

It is not without considerable difficulty that the homologies of some of the elements of the upper molars of *Coryphodon* are determined. The form of molar from which the *Coryphodon* type of tooth has probably arisen, occurs in the genus *Pantolambda*, which is from the Puerco or lowest Eocene beds of New Mexico. In *Pantolambda* both the external crescents of the superior molars are well developed, and the internal cone has two crests running out from it. Now what are the homologies of the anterior portion of the *Coryphodon* molar as compared with that of *Pantolambda*. The postero-external crescent is equally well developed in both forms, but what has become of the anterior crescent in *Coryphodon*, which is so strongly developed in *Pantolambda?* The prominent cusp (see Fig. *e.m.*) on the external face of all the superior molars of *Coryphodon* probably represents the reduced anterior crescent of *Pantolambda*. This is the homology advanced by Professor Cope. The anterior crest of *Coryphodon* has arisen by the development of the crest running outwards from the internal cone of *Pantolambda*. Thus it is by studying the earlier or more primitive types of many of the Mammalian phyla that we are enabled to interpret those marvellous changes which different parts of the dental and skeletal structures have undergone.

The structure of the last lower molar displays considerable variation; this affects particularly the elements of the heel (see lower Fig. *h.*). In the more primitive species the two cusps forming the heel are in a straight line, whereas in other varieties a small cusp may arise in the posterior valley of the heel, internal to the postero-internal cusps (*e, n, a*). The growth of this rudimentary cusp causes the pushing outwards of the



A superior and inferior molar of a typical species of Coryphodon (C. radians). *a. e. c.*, antero-external cone; *a. c.*, anterior crest; *i. c.*, internal cone; *e. m.*, external median cusp; *e. c.*, postero-external crescent; *a.*, anterior limb of crescent; *p.*, posterior limb; *h.*, heel of lower molar; *hy.d.*, external cone of heel; *en.d.*, internal cone.

internal of the two primitive cusps forming the heel; further growth causes the primitive internal cusp to occupy a median position, and it now fulfils the function of a fifth lobe of some of the other Ungulates. This postero-median cusp is merely an analogical structure, and its development proves that it is not homologous with the fifth lobe of the Lophiodonts.

The skeletal variations are many in this group, they affect principally the length and heaviness of the limb bones, and also the size of their articular extremities may vary a great deal.

The variations of the astragalus are particularly interesting, as upon them in some cases new genera have been established. A very primitive structure occurs in the tarsus of *Coryphodon*, as in all the other genera of the *Amblypoda;* that is, on the inner side of the astragalus, a separate bone, or rather a facet for this bone to articulate with, is present. The bone articulating with this facet is generally called the tibiale or internal navicular. Baur[1] has shown that the

[1] American Naturalist, January, 1885, p. 87.

tibiale occurs in the tarsus of the recent genera *Cercolabes* and *Erethizon* as it does in that of *Coryphodon;* therefore the presence of this bone must be considered as one of the primitive characters of the skeleton of this extinct group of Ungulates.

The relations of the tibiale facet to the other facets of the astragalus may vary a good deal, and in many cases the tibiale facet appears to be absent, whereas it is really not separated from the navicular facet of the astragalus.

In conclusion, I wish to add that I was led to write this abstract in order to show the numerous variations of the species of *Coryphodon*, and that in this group it is exceedingly difficult to say where one species ends and another begins. In most cases the characters run into each other so insensibly that it is almost impossible to separate the species. However, I believe there are about eight good species of *Coryphodon* whose characters show a progression from the primitive to the more specialized types; this progression and specialization affecting the teeth more particularly, as already described.

American Museum of Natural History, New York.

INDIAN NUMERALS.

BY EDWARD F. WILSON.

IN an essay on "The Origin of Languages," published several years ago by Mr. Hale, the idea is suggested that, as, for example, among our native Indians a family may, while hunting or in time of warfare, have chanced to become separated entirely from the rest of the tribe, father, mother, and elder members of the family may all have perished, and two or three little children have been left alone. Such children, Mr. Hale thinks, would gradually invent a new language of their own, retaining, perhaps, a few words or parts of words of their mother tongue. In this manner, he thinks, may be accounted for the remarkable diversity of tongues among the Indians of the Pacific coast, where among the mountains and forests a family might thus easily become isolated, and the comparative oneness of speech on the great central plains of this continent and in such an open country as Australia.

If there is any good foundation for such a theory as the above, we should expect that the old words retained by these young founders of new varieties of speech would be words of the simplest character and those most often in use in the domestic circle. And, indeed, I think we do find that fire, water, I, you, one, two, three, four, five are the words that generally approach the nearest to one another in a comparison of the different vocabularies.

The North American Indians, as a general rule, count by the decimal system, as do most civilized peoples; but it is noticeable that, after giving a distinct name to each figure from one to five, they, in many of the dialects, seem to commence anew with the figure six, the first part of that numeral sometimes being a contraction, or other form, of the numeral one, and the latter part of the word seeming to point on towards ten. Thus, in the Ojebway we have (1) pejig, (2) nij, (3) niswi, (4) niwin, (5) nanăn, (6) ningodwaswi, (7) nijwaswi, (8) nishwaswi, (9) shangaswi, (10) midaswi. It will be noticed here that from six to ten inclusive the termination is *aswi*. *Ningo*, with which six begins, is another form of pejig (1) never used alone, but only in composition, thus: ningo-gijik, one day; ningo-tibaiigan, one measure. In the Cree language (another Algonkin dialect, the first ten numerals are as follows: (1) peyăk, (2) niso, (3) nisto, (4) né o, (5) niya'năn, (6) nikotwasik, (7) tepakŭp, (8) ayena'new, (9) keka mita'tat, (10) mita'tat. Here it will be noticed that these Cree numerals resemble those of the Ojebways from one to six, but with seven they branch out into distinct words; then with ten they come together again, mita'tat not being dissimilar to midas'wi, and still more like midatching, the Ojebway equivalent for "ten times." Neither is the Cree numeral for nine so unlike that of the Ojebways as might at first sight appear. Keka mita'tat means "nearly ten," and this suggests that the Ojebway word shangaswi may mean the same, chegaiy or chig' being the Ojebway for near.

The reason for the decimal system being so prevalent all over the world, both among civilized and barbarous people, is doubtless the fact that human beings are possessors of ten fingers, five on each hand. The common manner of counting among the Indians is to turn down the little finger of the left hand for one, the next finger in order for two, the next for three, the next for four, and the thumb for five; then the thumb of the right hand for six, and so on until the little finger of the right hand is turned down for ten. In indicating numbers to others, the left hand held up with all the fingers turned down except the little finger would mean one; that and the next finger to it held up would mean two and so on. In counting by tens they will close the fingers of each hand to indicate each ten, or they will hold both hands up with the palms outward and fingers extended for each ten.

Some Indian tribes in counting resort to their toes as well as their fingers, and thus follow the vigesimal system. The Indians of Guiana, it is said, call five a hand, ten two hands, and twenty a man.

The Dakotas have a peculiar system of their own. When they have gone over the fingers and thumbs of both hands, one finger is temporarily turned down for *one ten*. At the end of the next ten another finger is turned, and so on to a hundred. Opawinge, one hundred, is derived from pawinga, to go around in circles, to make gyrations.

Indians are not generally good arithmeticians. In their native state they have no idea of making even the simplest mental calculation. To add or subtract they will use sticks, pebbles, or other such objects.

To illustrate the manner in which various tribes (some of them of different stocks) count from ten upwards, examples are herewith given from the Ojebway, Blackfoot, Micmac, and Dakota languages: With the Ojebways 10 is midaswi; 11, 12 are midaswi ashi pejig, midaswi ashi nij; 20, 30 are nij tana, nisimidana; 21, nij-tana ashi pejig; 100, ningodwak; 101, ningodwak ashi pejig. With the Blackfeet 10 is kepo; 11, 12, kepo nitsiko'poto; 20, 30, natsippo, niippo; 100, kepippo. With the Micmacs 10 is mtŭln; 11, 12, mtŭln tcel na-ukt, mtŭln tcel tabu; 20, 30 are tabu inskăăk, nasinskăăk; 21, tabu inskăăk tcel na-ukt; 100, kŭskimtŭlnakŭn; 101, kuskimtŭlnakŭn tcel na-ukt. With the Dakotas (or Sioux) 10 is wiktcemna; 11, 12, wiktcemna sanpa wanjidan (10 more one), wiktcemna sanpa nonpa; 20, 30 are wiktcemna nonpa (ten two), wiktcemna yamni; 21, wiktcemna nonpa sanpa wanjidan (ten two more one); 100 is opawinge, meaning a circle.

In some of the Indian languages there is more than one set of the cardinal numbers. Animate objects may be counted with one set, inanimate with another. They may have a particular set for counting fish or for counting skins; perhaps a set for counting standing objects, and another set for counting sitting objects, etc.

To give a few instances in the Ojebway tongue: nanan, nanominag, 5 globubar, animate objects, as turnips, seeds, etc.; nanonag, 5 boats or canoes; nanoshk, 5 breadths of cloth; and nanoshkin, 5 bags full (nūshkin meaning full); nanosag, 5 things of wood; nanwabik, 5 things of metal. In the Zimshian language (Brit. Columbia) guel means one if the object is neuter, gaul, if masculine or feminine, gou-uz-gūn, when the thing is long like a tree or pencil, ga'at, if a fish or animal is spoken of, gūmmet, if applied to a canoe; the other numerals change in the same way.

It is interesting to note that in the Ainu, the aboriginal language of Japan, a distinction is made in the numeral according as the object spoken of is animate or inanimate, thus: shinen, one person; shinep, one thing; tun, two persons; tup, two things.

Sault Ste. Marie, Ontario, June 22.

BLACK KNOT.

BULLETIN No. 40 of the New York State Experiment Station at Geneva (Peter Collier, director) contains a valuable summary of our present knowledge concerning this pest, from which the following is abstracted: —

The "Black Knot" is a disease of plums and cherries, which causes the formation of a hard, rough, black, wart-like surface on an enlarged or distorted outgrowth of the bark. The following statements, furnished by Mr. P. Groom Brandow of Athens, Green County, N.Y., indicate the former extent and value of the plum industry in that region and its total devastation by the Black Knot.

He states that, beginning at Cedar Hill, about four miles below Albany, the plum district included a belt about three miles on each side of the river and extended southward about thirty-six miles to Germantown. He began setting plums for a commercial orchard in 1861, and at one time had six thousand trees. Two of his neighbors each had about two thousand trees, and most of the farmers went into the business to a greater or less extent. It was no uncommon thing for a steamer to carry from one hundred to five hundred barrels of plums to New York at one trip. For four days' picking in one week he received $1,980. In 1884 he netted $8,000 from his plums, and the next year he rooted out over five thousand trees on account of the Black Knot. From twenty-five hundred young trees two to three years old, left at that time, he thinks he has not yet realized over $250.

It was formerly believed that Black Knot was produced by some gall insect, and it is not strange that this opinion prevailed on account of the gall-like character of the knots and the fact that they are frequently in ested by insects. Some believed it to be the work of the curculio, others thought that it was not the curculio, but some other insect or cause that produced the knots. But several years ago Dr. W. G. Farlow published, in the first annual report of the Bussey Institute, the results of his investigations, which proved conclusively that the Black Knot is caused solely by a parasitic fungus which grows within the bark, and which is now known to science by the name of Plowrightia morbosa. It is recognized as growing on cultivated cherries, and also on the wild red or yellow plum, the Chicasaw plum, the choke-cherry, the wild red cherry, and the wild black cherry. It is commonly most destructive to the plum, but also seriously attacks the cherry.

The external appearance of the mature form of the Black Knot is generally well known. It appears at this stage as a rough, wart-like excrescence, or distorted outgrowth, from the bark of twigs and branches, and in severe cases may extend along the trunk for several feet. The first outward sign of the formation of a new knot is seen in a swelling of the tissue within the bark either in the fall or during the growing season of the tree. The swelling increases till the bark is ruptured, and over the surface thus exposed the fungus sends out numerous threads (hypæ), which produce a velvety appearance and are of an olive-green color. Microscopic examination of the velvety surface reveals multitudes of newly formed and forming spores borne on these upright threads. These spores (conidia) are called summer spores. When full grown they drop off from the supporting threads, and when carried by winds, insects, or other agencies, to another host-plant, under favorable conditions they may start growth and form a new centre of disease, from which in time other trees may also be infested, and thus spread the disease from tree to tree and neighborhood to neighborhood.

The best way to deal with thoroughly infested trees is to cut them down and burn them at once, thus insuring the destruction of the spores before they spread the disease any further. Trees not badly infested may be treated by cutting off affected branches some distance below the knot. This operation is best performed in the fall immediately after the foliage drops, because the winter spores are not formed at that time and consequently there is less danger of their being disseminated in the operation, and also because the work can be done more thoroughly when there are no leaves to hide the knot. The summer spores must also be taken care of in their season. As soon as there is any indications of the formation of a new knot, in the spring or during the summer, the branch on which it occurs should be cut and burned. The first outbreak will probably be noticed about the middle of May.

It is important to note that if a branch containing the knot be cut from the tree and thrown on the ground, the spores will ripen in due time just the same. Therefore the practice of collecting carefully and burning every knot cannot be too strongly urged.

The bulletins of the Massachusetts Experiment Station contain some experiments in the application of various substances for the purpose of destroying the knot. Kerosene, turpentine, linseed oil, sulphate of copper, and a mixture of red oxide of iron and linseed oil are mentioned among the substances tried. These seem to be effective in destroying warts to which they are applied to saturation, but care must be used with the turpentine and kerosene or the entire branch will be killed.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

A Plea for the Study of Psychology.

THE perusal of a report, written by a member of the visiting committee of one of our universities, induced me to write these lines. In the course of the report, the remark is made that the study of psychology is difficult, and therefore few students take the study. The importance and advantage derived from studying a subject are to be considered more than its difficulty. Its usefulness is determined by its educational value; and surely there is no subject of study more useful and beneficial than psychology; for all persons who deal with people require a knowledge of this subject.

Since psychology has been taken out of the field of metaphysics, and has entered the domain of the natural sciences, it has developed marvellously. The accuracy and stability it has attained are proportionate to its development. Biology has brought about this change. The former position psychology occupied was not so much to determine the relation and connection between mind and organism as to determine the science of pure thought. But now psychologists have studied the brain, anatomists have dissected the cerebral lobes, chemists have analyzed the different substances of the nerves and brain, and its size, weight, shape, and specific gravity have been taken into account for the sole purpose of determining psychical phenomena; also the laws of development have been applied to the phenomena of the human mind. The study of animal instinct, the growth of children, the customs, habits, and beliefs of early tribes and races, the study of defectives, the study of the brain and the senses and the logical connections of ideas, have all received their share of attention. There is no psychical phenomenon and no act of human conduct which does not come within the province of psychology. The sciences of ethics, of theology, of law, of jurisprudence, of history, of medicine, of pedagogy, and of politics presume a knowledge of the workings of the human mind. For who, unless competent to analyze correctly and justly the feelings, desires, and motives that prompt action, would desire to determine the motives that underlie human conduct or pass upon the laws of right and wrong. How much more humane would a person be in his judgment upon the acts and conduct of another if he knew the causes of them. How many mistakes would be avoided in the training and education of the young, if parents and teachers were more conversant with the principles of psychology. How much more accurate could judges be in dispensing justice, if they were less dependent upon their personal experience, and knew more about the principles of psychology. What material aid could lawyers give in establishing the truth, if they were well versed in the study of psychology. How many grave blunders could be avoided, if statesmen and legislators understood more thoroughly the spirit of the times and the popular mind.

That the larger portion of professional men know little, if anything, about psychology cannot be denied, and if they do know something about the study, their knowledge is either founded on their personal experience and on common maxims, or it is derived from some book written from some particular standpoint. Most of such knowledge is incorrect and wrong, and it is one of the objects of psychology to correct these false notions.

In conclusion, I will quote John Stuart Mill, who has given an excellent statement of the reasons why psychology should be studied. He says: "Psychology, in truth, is simply the knowledge of the laws of human nature. If there is anything that deserves to be studied by man, it is his own nature and that of his fellow-men; and if it is worth studying at all, it is worth studying scientifically so as to reach the fundamental laws which underlie and govern all the rest. There are certain observed laws of our thoughts and our feelings, which rest upon experimental evidence, and, once seized, are a clue to the interpretation of much that we are conscious of in ourselves, and observe in one another. Such, for example, are the laws of association. Psychology, so far as it consists of such laws, is as positive and certain a science as chemistry, and fit to be taught as such."

FRANKLIN A. BECHER.

Milwaukee, Wis.

Ball-Lightning.

DURING a severe thunderstorm yesterday the phenomenon of ball-lightning was seen in this village. An inspection of the locality shows that the ball was located between a telephone wire and a conductor-pipe about three feet distant, and was doubtless of the nature of an electrical brush preceding the disruptive discharge. It was of a reddish color, and exploded with a report like a musket; but did no damage, nor was it attended by any smell perceptible to those who saw it, although they were distant not more than five feet.

M. A. VEEDER.

Lyons, N. Y., June 28.

BOOK-REVIEWS.

Animal Coloration. By FRANK E. BEDDARD. 8°. New York, Macmillan & Co.

IN the opinion of the writer the most concise and useful treatise upon the important subject of animal coloration has very recently appeared from the presses of Macmillan & Co. Its author, Mr. Frank E. Beddard, F.R.S., is especially favorably known in this country, among morphologists, through his numerous and admirable publications which have appeared in connection with his duties as prosector to the Zoological Society of London. That position, coupled with the fact that Mr. Beddard has made extensive collections of materials to illustrate his "Davis Lectures" on the subject of which his present volume treats, is ample evidence that he was peculiarly well fitted to deal with the subject. The work, a small octavo of some 300 pages, is gotten up with all that exquisite taste and style which has long ago made the house of the Macmillans so justly famous. Many excellent wood-cuts and several beautiful, colored lithographic plates illustrate its pages, they being especially devoted to giving striking examples of "protective coloration" among animals, as well as "protective mimicry," "sexual coloration," "warning coloration," "coloration as affected by environment," and numerous kindred topics. Completing the volume, we find a well-digested "General Index," and an "Index of Authors' Names." Among the latter we note those of many laborers in this country, and it is gratifying to see that America's work along such lines is upon the constant increase, and from year to year meets with enhanced favor. Our author, in his "Introductory," clearly defines the distinction between "Color" and "Coloration," the former being the actual tints which are found in animals, the latter simply referring to their arrangement or pattern. Of course, the terms become synonymous in uni-tinted animals. "The colours of animals are due either solely to the presence of definite pigments in the skin, or, in the case of transparent animals, to pigment in the tissues lying beneath the skin; or, they are partly caused by optical effects due to the scattering, diffraction, or unequal refraction of the light rays." Other matters more or less remotely bearing upon this part of the subject are briefly, though ably, dealt with, nothing of importance having been overlooked. Mr. Beddard has not remained satisfied with drawing upon any special class or group of animals for illustration, but has carried his investigations into all nature, touching in the most brilliant manner upon the significance of the colors and coloration of "deep sea forms," "cave animals," and indeed plant and animal growths from all parts of the globe. Nor has he omitted to discuss the theories of various other authorities than those advanced by himself; in short, the entire subject covered by this highly inviting field of research seems to be brought fully up to date, and in many instances the book even extends our knowledge. Biologists everywhere will thank Mr. Beddard for this contribution, and its modest price ($3.50) will constitute no real barrier to its soon appearing upon the shelves of every working naturalist in the United States.

R. W. SHUFELDT.

Takoma, D.C.

AMONG THE PUBLISHERS.

A NEW work on astronomy, entitled in "Starry Realms," has recently come from the press of J. B. Lippincott Company. The object of the work is to give the general reader some sketches of specially interesting matters relating to the heavenly bodies. The opening chapters are devoted to the more important relations of the sun to the earth, in which the author illustrates the different functions which the sun performs. The moon's history, and the phenomena attendant upon the lunar world, the planets, the meteors, the stars, are also ably considered. The work is embellished with ten full-page illustrations, and others in the text.

— Beginning with the July number, the magazine hitherto known as *Babyhood* will bear the name of *The Mother's Nursery Guide*, which expresses its purpose more fully and clearly than did the old appellation. There is no other change discernable in the essential features of the magazine, which looks back upon a

prosperous past of nearly eight years. The July number contains a summary, by the medical editor, of the present status of the question of milk sterilization, concerning the value of which the last word has not yet been said. "Baby's Flannels" forms the subject of another medical paper.

— The new edition of "Chambers's Encyclopædia" is rapidly nearing completion, and with the advent of one more volume this standard reference book will be at the command of all who are desirous of procuring a most accurate, convenient, and useful encyclopædia. The ninth volume has just been issued. Among the more important American articles are found San Francisco, St. Louis, St. Paul, Scandinavian Mythology, Sir Walter Scott, Sewage, Sewing Machine, Shakers, Shakespeare, Shelley, Phil. Sheridan, Sherman, Ship-Building, Silk, Silver, Slang, Soda, South Carolina, Spain, Sugar, Spiritualism, etc. These are all copyrighted, as are also the articles by American authors in all the volumes issued. The maps of this number include Russia, Scotland, South Australia, Spain, and South Carolina, prepared according to the latest geographical surveys. "Chambers's Encyclopædia" is never disappointing, its articles are well up to date, and a large number of entirely new subjects are introduced. The illustrations are incomparably the best ever issued in a work of this character. The volumes contain on an average nearly a thousand pages each. Volume X. will be issued in the fall. J. B. Lippincott Company are the American publishers.

— Messrs. Joseph Baer & Co., booksellers, Frankfort, are selling the botanical library of the late Professor L. Just, director of the botanical garden connected with the Polytechnicum at Carlsruhe. The list includes many important works in various departments of botanical science.

— In 1874 the British Association published a volume of "Notes and Queries on Anthropology," the object being to promote accurate anthropological observation on the part of travellers, and to enable those who were not anthropologists themselves to supply information wanted for the scientific study of anthropology at home. A second edition has long been wanted and a committee was appointed by the British Association to consider and report on the best means for bringing the volume up to the requirements of the present time. The committee recommended that the work should be transferred to the Anthropological Institute, and this proposal was accepted, the Association making grants amounting to £70 to aid in defraying the cost of publication. The new edition has now been issued, according to *Nature*, the editors being Dr. J. G. Garson and Mr. C. H. Read; and everyone who may have occasion to use it will find it thorough and most suggestive. The first part — Anthropography — has been entirely recast; the second part — Ethnography — has been revised, and additional chapters have been written. Among the contributors to the volume are Mr. F. Galton, Mr. A. W. Franks, Dr. E. B. Tylor, General Pitt-Rivers, and many other well-known authorities.

— The Open Court Publishing Co., Chicago, has just ready a second edition, revised and enlarged, of Gen. M. Trumbull's timely book on the tariff question, "The Free-Trade Struggle in England."

— Charles L. Webster & Co. announce that they will issue in book form Mr. Poultney Bigelow's Danube articles describing his canoe voyage down that river, the title of the book being "Paddles and Politics Down the Danube."

— In *Lippincott's Magazine* for July "Peary's North Greenland Expedition and the Relief" is well and interestingly covered by W. E. Hughes and Benjamin Sharp. Gertrude Atherton contributes a short essay on "Geographical Fiction."

— Charles H. Sergel & Co., Chicago, have just issued in their series of Latin-American Republics "A History of Peru," by Clements R. Markham, which gives a complete history of the country from the conquest to the present time.. They have in press for the same series "A History of Chile," by Anson Uriel Hancock; and in active preparation "A History of Brazil," by William Eleroy Curtis; "A History of Argentine," by Mary Aplin Sprague; and "A History of Bolivia," by T. H. Anderson, U. S. Minister to Bolivia.

— Macmillan & Co. have just ready "The Barren Ground of Northern Canada," by Warburton Pike, with maps.

— Chain & Hardy Co., Denver, Col., have just ready a little pamphlet, entitled "Review of Ore Deposits in Various Countries," by Rudolf Keck, of Colorado Springs, Col.

— G. P. Putnam's Sons have just ready an important work on "The English Language and English Grammar, being an historical study of the sources, development and analogies of the language and of the principles governing its usages, illustrated by copious examples from writers of all periods," by Samuel Ramsey; the fifth and concluding volume of the "Memoirs of Talleyrand;" "Earth-Burial and Cremation," a history of earth-burial with its attendant evils, and the advantages offered by cremation, by Augustus G. Cobb, formerly President of the U. S. Cremation Society and Vice-President of the New York Cremation Society.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Botanical Laboratory, A.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cercopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School of Applied Science.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diphtheria, Tox-Albumin.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, The New Method of Protecting Buildings from.
Lissajou's Curves, Simple Apparatus for the Production of.
Maize Plant, Observations on the Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Some Recent, in the State of Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
Patent Office Building, The.
Physa Heterostropha Lay, Notes on the Fertility of.
Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
Psychological Laboratory in the University of Toronto.
Psychological Training, The Need of.
Psylla, the Pear-Tree.
Rain-Making.
Rivers, Evolution of the Loup, in Nebraska.
Scientific Alliance, The.
Sistrurus and Crotalophorus.
Star Photography, Notes on.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

Aaron, Eugene M., Philadelphia, Pa.
Allen, Harrison, Philadelphia, Pa.
Baldwin, J. Mark, University of Toronto, Canada.
Barnes, Charles Reid, Madison, Wis.
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Bostwick, Arthur E., Montclair, N J.
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Brinton, D. G., Philadelphia, Pa.
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Hale, George S., Boston, Mass.
Hale, Horatio, Clinton, Ontario, Canada.
Hall, T. Proctor, Clark University, Worcester, Mass.
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Haworth, Erasmus, Oskaloosa, Iowa.
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Lintner, J. A., Albany, N. Y.
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Osborn, Herbert, Agricultural College, Ames, Iowa.
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Pillsbury, J. H., Smith College, Northampton, Mass.
Poteat, W. L., Wake Forest, N. C.
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Ruffner, W. H., Lexington, Va.
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Schufeldt, R. W., Washington, D.C.
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Southwick, Edmund B., New York City.
Stevens, George T., New York City.
Stevenson, S. Y., Philadelphia, Pa.
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True, Frederick W., National Museum, Washington, D.C.
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Wake, C., Staniland, Chicago, Ill.
Ward, R. DeC., Harvard University, Cambridge, Mass.
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Warder, Robert B., Howard University, Washington, D.C.
Welch, Wm. H., Johns Hopkins University, Baltimore, M.D.
West, Gerald M., Clark University, Worcester, Mass.
Whitman, C. O., Clark University, Worcester, Mass.
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SCIENCE

NEW YORK, JULY 8, 1892.

DIAMONDS IN METEORITES.

BY OLIVER WHIPPLE HUNTINGTON.

ɛ mineral cabinet of Harvard College received some ago, through the liberality of Francis Bartlett, Esq., ' the two large masses of meteoric iron first brought by . E. Foote from Arizona, and called by him the Cañon) iron. This mass of iron, weighing 154 pounds, is in ways unique, and chiefly so for the circumstance that tains diamonds.

s fact was first made known by Professor G. A. Koenig iladelphia, who found in cutting one of the fragments ıe cutting tool refused to penetrate the wall of a small which it chanced to encounter, and this cavity was to contain small black diamonds.[1] One white dia- of microscopic dimensions was said to have been but subsequently lost, and no further account of this sting occurrence appears to have been published.

ɔrder to determine whether other portions of the Cañon) iron contained diamonds, the author dissolved a mass ɔut one hundred grams weight in acid, assisted by a y. The iron was supported on a perforated platinum ıung in a platinum bowl filled with acid, and the cone ıade the positive pole and the dish the negative pole of ısen cell. When the iron had disappeared, there was n the cone a large amount of a black slime. This was tedly washed and the heavier particles collected. This ıe examined under a microscope showed black and particles, the black particles being mainly soft amor- carbon, while the composition of the white particles red less easy to determine, though when rubbed over a -glass certain grains readily scratched the surface.

ı material was then digested over a steam-bath for hours with strong hydrofluoric acid, and some of the particles disappeared, showing them to have been us. Most of them, however, resisted the action of the These last were carefully separated by hand, and ap- l to the eye like a quantity of fine, white, beach sand, nder the microscope they were transparent and of a nt lustre. A single particle was then mounted in a ɔf metallic lead, and when drawn across a watch-crystal e out the familiar singing noise so characteristic of a ɔutter's tool, and with the same result, namely, of actually g the glass completely through. To verify the phe- ıon, successive particles were used for the purpose, and he same result. The experiment was then tried on a and the same little mineral point was found to scratch almost as readily as it did glass. It was finally ap- ɔ a polished sapphire, and readily scratched that also, ıg beyond question that this residue of small, white, arent grains must be diamond, though no well-formed ls could be recognized.

as long been known that carbon segregates from mete- on in the form of fine-grained graphite; and, when Haidinger found in the Arva iron a cubic form of graphite, it was suggested by Rose that the crystals might be pseudo-morphs of graphite after diamond. More recently Fletcher described a cubic form of graphite from the Youngdegin meteorite, under the name of Cliftonite.[2]

Finally, a meteoric stone which was seen to fall at Nowo-Urei, in Russia, in 1886, was discovered two years later to contain one per cent of a carbonaceous material, which not only had the crystalline form of the diamond but also its hardness, so that, instead of being regarded as a pseudomorph after diamond, it was compared with the black diamonds of Brazil, called "carbonado."[3] And, lastly, in the Cañon Diablo iron we have true diamonds, though of minute dimensions. Thus it would appear that, under certain conditions, metallic iron is the matrix of the diamond.

Now, we further know that when cast iron is slowly cooled a considerable portion of the carbon separates in the condition of graphite. Moreover, the high specific gravity of the earth as a whole, as compared with the materials which compose its crust, give us ground for the theory that the interior of our planet may be a mass of molten iron. Therefore it would seem to be not an unreasonable hypothesis, that diamonds may have been separated from this molten metal during the formation of the earth's crust; and a support for this hypothesis may be found in the fact that at the Kimberley mines of South Africa diamonds occur in, what appear to be, volcanic vents, filled with the products of the decomposition of intrusive material thrown up from great depths.

The late Professor H. Carvill Lewis, in examining the materials from the greatest depths of the South African mines, came to the conclusion that the diamonds were formed by the action of the intrusive material on the carbonaceous shale there found, and on this ground predicted the discovery of diamonds in meteorites;[4] but it must be remembered that a similar geological phenomenon appears on a grand scale in Greenland, and no diamonds have as yet been found in the Greenland irons, though they have been so carefully studied by the late Professor J. Lawrence Smith and others.

It is difficult to conceive of any chemical reaction by which diamonds could be formed from the action of melted igneous rock on coal, and all attempts to prepare diamonds artificially by similar means have signally failed.

The writer would urge that the segregation of carbon from molten iron is a well-known phenomenon, and the association of diamonds with amorphous carbon in the meteorite from Arizona indicates that under certain conditions such a segregation may take the form of diamond. The chief of these conditions is doubtless the length of time attending the crystallization, though it may also be affected by pressure; and if the earth, as many believe, is simply a large iron meteorite covered with a crust, it seems perfectly possible that if we could go deep enough below the surface we should find diamonds in great abundance.

[1] American Journal of Science, Vol. XLII., November, 1891.

[2] Min. Mag., 7, 121, 1887.

[3] American Journal of Science, xxvi., p. 74.

[4] British Association, 1886, p. 667.
Ibid, 1887, p. 720.

THE NUMBER OF BROODS OF THE IMPORTED ELM-LEAF BEETLE.

BY C. V. RILEY.

AT the meeting of the Entomological Club of the A.A.A.S. in Washington last autumn, Professor John B. Smith, it will be remembered, gave some interesting observations on this beetle, made at New Brunswick, N.J. As the somewhat astonishing result of his observations, he stated that there was but one annual generation, and that the beetles actually went into hibernating quarters early in August. Professor Smith's statements were so emphatic, and evidently based on such careful observations, that they could not very well be gainsaid, but as they conflicted with my observations on the species in the latitude of Washington, for which I have recorded two generations, and exceptionally a third, I was anxious the present season to go over the ground again, still more carefully than in the past, and, by rearing in confinement the first generation of larvæ from the first eggs hatched, to thus verify, in a manner which could leave no possible doubt, the facts which I had previously recorded.

In this brief note, I desire simply to state that at the present time (June 30) I have eggs laid by the second brood of beetles, i.e., the beetles obtained from larvæ which were feeding during the month of May and early part of June, thus proving, in the most positive manner, that in the latitude of Washington there are at least two broods, and that the second brood of larvæ will be feeding during July.

The following from the Appendix to the second edition of Bulletin 6, Division of Entomology, Department of Agriculture, October, 1891, will bear repeating in this connection:—

"One statement in the life-history of the Imported Elm-Leaf Beetle, as given in the preceding pages, may have to be corrected in the light of the observations of the past six years, and that is in reference to the number of annual generations. Like other leaf-beetles, this insect occupies an extended time in oviposition. The eggs appear to develop slowly in the ovaries, and a single female will deposit a number of the characteristic little yellow batches. This fact, taken in connection with the retardation of certain individuals of a generation, results in an inextricable confusion of broods. Adult beetles, pupæ, larvæ in all stages, and eggs, will be found upon trees at the same time, in Washington, during the months of June, July, August, and even later. From this fact it is almost impossible to estimate the number of annual generations without the most careful breeding-cage experiments. There is no evidence that the facts upon record are based upon such careful experiments. Glover, in the annual report of this department for 1867, page 62, says: 'After becoming pupæ, in a few days the skin of the back splits open and the perfect insect crawls forth, furnished with wings, by means of which it is enabled to fly to other trees and deposit its eggs, thus spreading the nuisance to every elm in the neighborhood; or it may ascend some tree and lay the eggs for a *second generation*, which destroys the second crop of leaves, frequently so enfeebling or exhausting the tree that it is unable to recover and eventually perishes.' Again, in the Annual Report for 1870, page 73, he says: 'The perfect beetles appear in a few days and immediately fly up into the tree to lay their eggs for a *second generation*, which frequently destroys every leaf on the tree.'

"The European records seem strangely silent upon this point. In the articles by Leinweber and Frauenfeld, referred to upon page 6, there is no indication of the number of generations, but it may be inferred that only one, namely, that of June and July, has been under observation. Heeger, however (*loc. cit.*, p. 114), says that 'under favorable circumstances there are three to four generations during the whole summer. Toward the end of August the insect ceases feeding and retires—partly as larvæ and partly as beetles—to winter rest under fallen leaves, in the cracks of bark, holes in the trunks of the trees, and in the ground itself.' This observation was made near Vienna.

"Our statement upon page 8 was a general one, based upon the observations in August. This state of affairs may probably hold in more northern regions, but in Washington it is safe to say that there are two generations, because, as just stated, newly developed beetles (the progeny of those which hibernate) appear in early June. These lay eggs, and, in fact, egg-laying may continue until the end of September, and larvæ have actually been found by Mr. Pergande in October."

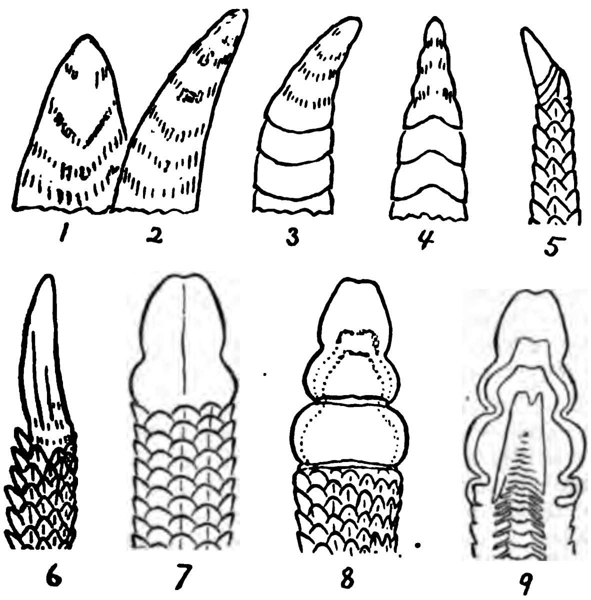
THE REPTILIAN RATTLE.

BY S. GARMAN.

AMONG the specimens secured by Dr. Georg Baur, in his explorations of the Galapagos Islands, there are a number of large lizards of the genera Conolophus and Amblyrhynchus, which exhibit certain peculiarities in the spines of the dorsal crest. Externally each of the spines resembles the rattle of a small rattlesnake. The likeness was evidently brought about by causes similar to those through which the rattle was originated. In a measure, these spines confirm my statement of the evolution of that organ as published in 1888 (Bull. Mus. Comp. Zool., viii., 259). Figures 1–4, herewith, represent a couple of the nuchal spines in a lateral aspect and views, side and front, of one of the dorsal spines of the Galapagos lizard, Conolophus subcristatus. On making a longitudinal section of any of these spines they are seen to be wholly dermal and to contain neither bones nor muscles. Their epiderm is a little thicker than that of the scales on the flanks. It is apparent that for a time, after hatching, growth of the skin was rapid and regular. The spines developed during this period were subpyramidal; they tapered so much, on back as on neck, that the slough came off readily and was lost. A periodic growth was taken on in later stages, and, the spines having become more elongate, a slight constriction was formed around the base, from folding the skin by bending the spine from side to side. Becoming still more elongate, the foldings meanwhile increasing in extent and depth, a stage was finally reached which, mayhap aided by shrinkage, retained the epiderm of the spine in place as a cap after the general slough was cast. Thus one thickness after another was added to the covering of the spine, each of the older being shoved farther up, by growth, so as to expose below it a band of the newer cuticle. The folded lower edge, the collar, of the cap rested in a basal groove or furrow, and prevented displacement. Each cap was closely applied to that beneath it, and the spine as a whole was solid. Outwardly the spines resemble rattles; internally the caps rest one upon another too closely to rattle.

The tip of the tail of the common snake ends in a spine somewhat like that in the crest of the lizard. It differs in containing a bone, the end of the vertebral column. Sloughing is similar in the two cases, a slight variation only being induced on account of the included vertebra. On most snakes the spine tapers greatly, and the cap is carried off in

the slough. On a few there are constrictions and ridges around the cap, that recall those on the spines of the lizard. As it happens, those marked in this manner are the nearest living allies of the rattlesnakes. In the paper on the Evolution of the Rattle, above cited, the copperhead, Ancistrodon (Fig. 5), was brought forward as most nearly representing the ancestor of the smaller rattlesnakes, Sistrurus; and the bushmaster, Lachesis (Fig. 6), of northern South America, was suggested as the most likely for the large rattlers, Crotalus. These forms were pointed out as so nearly approximating a condition from which the possession of a rattle was a necessary consequence that we might at any time expect to find individuals on which the caps were mechanically retained. My conclusions in regard to the inception of the rattle seem to be indirectly confirmed by what obtains on the lizards. This will be the more apparent if it is borne in mind that the present development of the rattle (Figs. 7–9) embraces much that is a consequence of its



Figs. 1–2, nuchal spines, and 3–4, a dorsal spine of Conolophus subcristatus; Fig. 5, tail of Ancistrodon contortrix; Fig. 6, tail of Lachesis mutus; Fig. 7, Sistrurus catenatus, at birth; Figs. 8–9, Crotalus confluentus.

possession, much that has been induced by its presence and use. The greater part of the shortening-forward in the extremity of the tail, of the compacting and consolidation of the posterior vertebræ, with the enlargement of the cap to include them, and much of the development of the caudal muscles must be eliminated before one can realize the primary condition of the rattle, a condition which was, no doubt, but a little advanced upon that now existing in Ancistrodon and Lachesis, as sketched in Figs. 5 and 6.

Mus. Comp. Zool., Cambridge, Mass.

OPPOSITION OF MARS.

BY EDGAR L. LARKIN.

THE coming opposition of Mars will be of interest to astronomers throughout the world; and extensive preparations are being made to observe it. The face of the god of war is sure to be watched, drawn, and photographed with more care than ever before. And the most perfect spectroscopes made will be turned on his ruddy disk. The sun, earth, and Mars will be on the same straight line nearly, on Aug. 3 at 13 h. 13 m., or at 1 h. 13 m. A.M., Aug. 4, 1892. The time of the opposition will be favorable for observation, since the earth passes its aphelion on July 1, while Mars does not pass his perihelion until Sept, 7. That is, the earth will be 34 days only past the time when at its greatest distance from the sun; and Mars but 35 days from its nearest approach. If these dates could coincide — opposition take place when the earth is at a maximum and Mars at a minimum distance from the sun — then would the earth and Mars be at a minimum distance from each other, or 33,864,000 miles; in which computation a solar parallax of 8.8″ and a mean distance of Mars of 141,500,000 miles were employed. However, since the opposition will occur midway between, it is probable that, at the moment of the nearest approach of the two planets, they will be distant about 35,500,000 miles.

The last opposition favorable for close observation was on Sept. 5, 1877; at which approach, Prossessor Asaph Hall discovered two minute moons in revolution around our neighboring world. This important discovery is best given in Professor Hall's own language: "The sweep around the planet was repeated several times on the night of Aug. 11, and at half-past two o'clock I found a faint object on the following side and a little north of the planet, which afterwards proved to be the outer satellite. On Aug. 16 the object was found again on the following side of the planet. On Aug. 17, while watching for the outer satellite, I discovered the inner one." Perhaps this optical discovery reveals the power of modern telescopes in a manner more impressive than any other, thus: "The outer one was seen with the telescope at a distance from the earth of 7,000,000 times its diameter. The proportion would be that of a ball two inches in diameter viewed at a distance equal to that between the cities of Boston and New York" (Newcomb and Holden, "Astronomy," p. 338).

These moons were seen with the 26-inch glass at Washington; but now a 36-inch telescope is in waiting for Mars, and none can predict what will be discovered. The satellites are estimated to be 6 and 7 miles in diameter; and they have a most rapid motion. It is well to note some of the facts about these bodies that served a great purpose, in sweeping away that mythology of astronomy, the nebular hypothesis. Distances from centre of Mars: Deimos, 14,600 miles; Phobos, 5,800 miles. Times of revolution: Deimos, 30 h. 18 m.; Phobos, 7 h. 39 m. But it requires 24 h. 37 m. for Mars to turn on its axis, which divided by 7 h. 39 m. equals 3.22; that is, the inhabitants of Mars have 3.22 months of Phobos every day. This moon rises in the west and passes through a phase in 1 h. 55 m. Deimos is 130 h. 37 m. from rising to rising, or 65 h. 18 m. from rising to setting. Its gain over the rotation of Mars is 3° 24′ per hour, hence it requires 106 hours to gain a whole revolution, which, added to the diurnal rotation of the planet, gives the 130 h. 37 m. But 65 h. 18 m. equals 2.155 months of Deimos; therefore the other satellite passes more than two full sets of phases while above the martial horizon, with plenty of eclipses beside.

The main interest in the next opposition rests in the hope that an accurate map of Mars can be made, or that good photographs can be secured, or that the spectroscope may make further revelations concerning the absorption of solar rays by its atmosphere, or that the lines due to the vapor of water may be seen to better advantage, if possible, than at the last. Professor C. A. Young, "Astronomy," p. 337, says: "The probability is that its density is considerably less than that of our own atmosphere. Dr. Huggins has found with

the spectroscope unequivocal evidence of the presence of aqueous vapor."

The idea that water exists on Mars is supported by the fact that white patches are seen on the poles, and that these vary in size with variations of inclination of the axis toward the sun. The white area is now well seen at this observatory on one of the poles. So rapid has been the advance in celestial photography, and in spectroscopy, and also in the size of telescopic objectives during the last 15 years, that without doubt much additional knowledge of Mars will be gained in August.

Knox College Observatory, Galesburg, Ill., July 1.

CROSS-FERTILIZING AND HYBRIDIZING.

THE following excellent suggestions are from the eminent horticulturist, Professor T. J. Burrill, of the Illinois experiment station. The subject is one calling for the co-operation of farmers and fruit growers everywhere with the experiment stations, for where nature has laid the foundation for improvement by giving us such a wild seedling as the Concord grape, that should be made the basis for further work.

Cross-fertilizing and hybridizing have been carried on to some extent, both for the effects of crossing and for the purpose of producing, if possible, new varieties of value. A number of crosses have been made in the apple, as for instance, between Ben Davis and Grimes, Ben Davis and Minkler, or Ben Davis and Duchess, with a view of getting something that will bear like the Ben Davis, but have the better quality of Grimes or Minkler, having the keeping quality of Ben Davis and the hardiness of tree of the Duchess. Different varieties of strawberries have been crossed, and plants are growing from the crossed seed. Blackberry varieties have been crossed, seeds planted, and plants are growing. Raspberries have been crossed — black varieties together, red varieties together, black with red, and blackberries with raspberries. We have now ready for planting more than a quart of seed from crossed raspberry and blackberry, or from selected varieties.

Results are problematical, but there is certainly great room for improvement in our blackberries and raspberries. There is entirely too much seed for the amount of flesh. When we consider that our apples originated from a crab in no way superior to many of our own native wild crabs, and the excellence that has been developed by cultivation and selection, what may we not expect from our raspberries and blackberries, which are so much better naturally? We have only begun with the raspberry and blackberry group of plants. I believe none of the blackberries or dewberries now cultivated are the result of growing plants from seed, but that all are the result of propagating natural seedlings, and it is not at all certain that we have yet the best of the wild varieties. Most of our raspberries are the result of chance.

During the past three seasons some work has been done in the line of crossing and selecting corn. The results seem to indicate that corn grown from crossing two distinct varieties will be larger than the average of the kinds crossed, or where the parents are nearly equal in value. To be sure, nothing has yet been reported in that line, though there would seem to have been abundant time for seedlings to have been grown. If the results of our crosses in corn are to serve as an index, we might expect to find in a second or *third generation fruit of the Vinifera type* on vines of the Labrusca. There is a great difference in the susceptibility of fruits to the influence of man. Our grapes have had more time spent on them, extending over a longer period, than have our strawberries; yet the results from grapes are hardly to be compared with the results from strawberries.

A small start has been made in the growth of nuts. The attempts at improvement heretofore have been confined almost exclusively to the pecan and chestnut. Attempts at improvement by growing seedlings from the best native trees have usually been a disappointment, because the seedlings have been inferior to the tree from which seed was taken, just as 999 of every 1,000 seedlings grown from the Concord grape have been so inferior to the parent as to be unworthy of general distribution. But it must be remembered that while there are comparatively few chances for improvement by growing seedlings there are none from simply budding or grafting.

The filbert and walnut of Europe are too tender for our climate. Why may not our hazel-nut and walnut be improved so as to take their places, and be made valuable crops for the rough lands along our streams?

NOTES AND NEWS.

AN interesting feature has been added to the first United States Food Exhibition, to be held at Madison Square Garden, New York, in October next, in the way of a national exhibit of dairy products. This department will be in charge of Professor James Cheesman, who represented the dairy interests of the United States at the late Paris Exposition. Professor Cheesman has a wide reputation as a dairy expert and as an authority on all matters pertaining to the dairy interests. This part of the exposition promises to be one of its most popular features.

— The *Journal de Colmar* of June 19 says: The president of the committee entrusted with the erection of a monument to Hirn has received a letter from the maire of Strasburg, in which he makes the following statement: "I have the pleasure of announcing that, upon the receipt of your letter of the 23d, relative to the participation of the city of Strasburg in the erection of a monument to M. G. A. Hirn, the municipal council has determined to contribute to this work the sum of 800 marks. I have ordered this amount to be credited to you, and it may be obtained from the municipal collector, who will transfer it to the treasurer of the committee, M. Baer. I trust that the example of Strasburg will find many imitators."

— Cornell University closed the college year 1891-2 on June 16, conferring above 300 degrees, of which about one-half were in scientific and technical courses, and a large number of which were the higher degrees. The graduating class was the largest in the history of the University, and is said to have been the strongest. The year terminates the connection of a number of the members of the faculty with the university, and this fact and the anticipated growth for the coming year will render it necessary to appoint a still larger number of new professors and instructors. The indications, judging from the numbers entering at the June examinations, are said to point to an entering class in September of not far from 500, and of probably fifteen or twenty per cent more in the upper classes and as graduate students, making a probable total of about 1,600 in all departments and classes. Sibley College, with its special and graduate schools and departments in mechanical engineering, will prepare for a total of 625 students, a hundred more than in 1891-2. In addition to new appointments already made, it is expected that professorships will be filled in geology, chemistry, and possibly one or two other subjects; also a number of assistant professorships and many instructorships in all departments, including physics, engineering, and mechanic arts. The appointments in scientific departments are usually such as demand familiarity with laboratory instruction, especially in electricity and mechanics.

— A Geographical Exhibition, we learn from the Proceedings of the Royal Geographical Society, will be opened this summer at Moscow, in connection with the two International Congresses of Prehistoric Archæology and Anthropology, which are to be held in the ancient Russian capital. The General Staff will exhibit a collection of all the maps, descriptions, and surveys made by Russian travellers in Central Asia, China, and Korea, which are deposited in the Topographical Department of the General Staff and the Scientific Military Committee. They will show also the recently-published maps, based upon surveys in the Empire and adjacent countries. A catalogue of these works is now in preparation.

— The degree of M.A. was conferred, *honoris causa*, upon Professor Edward Sylvester Morse at the recent Harvard commencement. Professor Morse was born in Portland, Me., in 1838. When but thirteen years of age he began to form a collection of minerals and shells. His first occupation was as a mechanical draughtsman at the Portland locomotive works. Afterward he made drawings on wood for a Boston concern. In 1852 he began a course of study under Agassiz at the Museum of Comparative Zoology in Cambridge. In 1866 he founded the *American Naturalist*, now published in Philadelphia. In 1868 he was made a fellow of the American Academy of Arts and Sciences. In 1871 Bowdoin College gave him the degree of doctor of philosophy. In 1874 Harvard elected him to a university lectureship, and he was also chosen vice-president of the American Association for the Advancement of Science, of which association he afterward became president. While studying marine zoology in Japan he accepted a professorship in the Imperial University at Tokio. He made several other visits to Japan, and formed a collection which was recently sold to the Boston Museum of Fine Arts. Professor Morse is also the inventor of numerous ingenious appliances for both scientific and domestic uses.

— The British consul in Hainan, in his last report, says, according to *Nature*, that during the past year he has made two journeys in that island, one to certain prominent hills near Hoihow, known as the "Hummocks," which lie fifteen miles to the west, on the road to Ch'eng-mai, the other a gunboat cruise to Hansui Bay. The people at both these places, and presumably all along the north-west coast, though believing themselves Chinese, speak a language which is not only not Chinese, but has a large percentage of the words exactly similar to Siamese, Shan, Laos, or Muong. The type of the people, too, is decidedly Shan, without the typical Chinese almond eye. At one time (1,000 years ago) the Ai-lau or Nan-chau Empire of the Thai race extended from Yun-nan to the sea, and the modern Muongs of Tonquin, like the Shans of the Kwangsi province, the ancestors of both of which tribes belonged to that empire, probably sent colonies over to Hainan; or the Chinese generals may have sent prisoners of war over. It is certain that some, at least, of the unlettered, but by no means uncivilized, tribes in the central parts of Hainan speak a type of language which is totally different from that spoken by the Shan-speaking tribes of the north-west coast. Yet the Chinese indiscriminately call all the non-Chinese Hainan dialects the Li language. The subject, Mr. Parker says, is one of great interest, well worth the attention of travellers. It was his intention to pursue the inquiry when making a commercial tour of inspection round the island, but his transfer to another post compels him to abandon his scheme.

— The latest researches of the Finnish expedition to the Kola Peninsula will modify, as we learn from *Nature*, the position of the line which now represents on our maps the northern limits of tree-vegetation in that part of Northern Europe. The northern limit of coniferous forests follows a sinuous line which crosses the peninsula from the north-west to the south-east. But it now appears that birch penetrates much farther north than the coniferous trees, and that birch forests or groves may be considered as constituting a separate outer zone which fringes the former. The northern limits of birch groves are represented by a very broken line, as they penetrate most of the valleys, almost down to the sea-shore; so that the tundras not only occupy but a narrow space along the sea-coast, but they are also broken by the extensions of birch forests down the valleys. As to the tundras which have been shown of late in the interior of the peninsula, and have been marked on Drude's map in Berghaus's atlas, the Finnish explorers remark that the treeless spaces on the Ponoi are not tundras but extensive marshes, the vegetation of which belongs to the forest region. The Arctic or tundra vegetation is thus limited to a narrow and irregular zone along the coast, and to a few elevated points in the interior of the peninsula, like the Khibin tundras, or the Luyavrurt (1,120 metres high). The conifer forests, whose northern limit offers much fewer sinuosities than the northern limit of birch-growths, consist of fir and Scotch fir; sometimes the former and sometimes the latter extending up to the northern border of the coniferous zone.

— A sealed bottle containing a paper requesting the finder to report the place and date of discovery was thrown into the sea at Coatham Pier, Redcar, by Mr. T. M. Follow, on Oct. 8, 1891. On April 12, 1892, according to the Proceedings of the Royal Geographical Society, the bottle was picked up by a fisherman off the island of Hjelmesö, in the extreme north of Norway. The bottle had been immersed for six months, and the shortest distance between the two points is 1,409 miles. This observation confirms the general set of the currents from the east coast of Britain, at first south-easterly and then northerly along the continental coast, as shown in Mohn's map of surface drift in the North Sea and Norwegian Sea in Petermann's "Ergänzungsheft," No. 79, for 1885.

— The Russian *Official Messenger* (April 22) announces that the Ministry of Domains has decided to make, next summer, the following explorations in Caucasia: (1) The exploration of the mineral springs of the Eastern Caucasus having now been completed, to carry out a similar work in Central and West Transcaucasia; namely, the mineral waters of Khvedur, Uravel, Tsikuban, Platen, and others, in the governments of Tiflis and Kutais, and in the Chernomorsk District; (2) to continue the systematic geological exploration of the government of Tiflis, especially of the valleys of the Yora and the Alazan in Kahetia, and their mineral resources, in view of the projected construction of a railway in Kahetia; and (3) as the detailed study of the Apsheron naphtha region was terminated last year, and the map of the region is ready, to complete the exploration of the Caspian coast naphtha region, and to explore the nickel ores of Daghestan. The geologist, Simonovich, and the mining officers, Konshin, Barbot-de-Marny, and Gavriloff, are commissioned for this purpose, while M. Rughevich is commissioned to explore the naphtha region along the new Petrovsk branch of the Vladikavkaz Railway, which yielded last year 15,000 tons of naphtha, and promises to become an important centre of naphtha industry.

— Professor Elihu Thomson, the inventor of the Thomson-Houston Electric Company, contributes an entertaining, scientific, and thoughtful paper on "Future Electrical Development," to the July *New England Magazine*. He explains the possibilities of electricity, in all the public and private conveniences of life, and gives practical examples of its application to manufactures, rapid transit, and domestic offices, such as cooking, ironing, heating, gardening, raising fruit and vegetables, etc.

— Macmillan & Co. announce the issue of a new and extensively revised edition of Mr. Bryce's "American Commonwealth." It is to be expected that this new edition will take notice of the many important changes which have occurred since the work was first issued. It is to be copyrighted in America. The same publishers have already issued more than half of Stephen's "Dictionary of Biography," one volume of which is published quarterly. Thirty out of a total of fifty volumes have appeared so far, and the enterprise is so well in hand that there will be no break in the publication of the remaining parts. The work when completed will contain at least thirty thousand articles by writers of acknowledged eminence in their several departments. The memoirs are the result of personal research, and much information has been obtained from sources that have not before been utilized. It has been the aim of the editors to omit nothing of importance and to supply full, accurate, and concise biographies, excluding, of course, those of persons still living.

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ON THE UNCERTAINTY OF CONCLUSIONS.[1]

BY T. C. MENDENHALL.

ABOUT seven years ago, on the morning of a cold day in winter, a rough-looking, scantily-dressed man was observed to leave a freight car, which was standing upon a side-track near a small country town, and make his way rapidly into the fields and woods beyond.

From his appearance it was evident that he belonged to that vast army of tramps which is never in need of mobilization and which carries upon its muster-rolls many who possess most of the virtues of the good and none of the vices of the bad, having lost only the power of further resistance against continued antagonism and unfriendly environment.

The behavior of this man excited no comment, and his existence was remembered a few hours later only because of the discovery of the body of a stranger, who had evidently been murdered, on the floor of the car which he had been seen to leave. Pursuit followed immediately, and capture within a day or two. One or two clever detectives interested themselves in finding evidence of his guilt, and within a few days had prepared a case which lacked little in the detail of its elaboration or in its artistic finish.

It was proved that two strangers were seen in the suburbs of the town at a late hour on the previous night, although they were not together. The prisoner was identified beyond doubt as the man who hastily left the car in the morning. The murderer had left no means of identification except a small piece of muslin, evidently torn from the sleeve of his shirt, and which was stained with the blood of his victim. On the arrest of the prisoner one or two blood stains were found upon his clothing, and, what was more convincing than all else, the bit of sleeve found in the car fitted exactly into the place in his own garment, from which it must have been torn in the struggle which preceded the crime.

[1] Address as retiring president, delivered Jan. 20, 1892, before the Philosophical Society of Washington.

While all of this evidence might be classified as "circumstantial," it was so complete and satisfactory that no jury could be expected to entertain serious doubt as to the guilt of the prisoner, and, in spite of his protestations of innocence, a sentence to life imprisonment was in accord with the judgment of the general public.

Only a few weeks since this man was set free and declared to be innocent of the crime for which he had already served seven years at hard labor, the misleading character of the evidence on which he was convicted having been exposed through the voluntary confession of the real criminal. The facts thus brought out were, briefly, as follows: —

There were three men in the case. The first, who was afterward murdered, slept upon the floor of the car when the second, the real murderer, entered it. In the dark he stumbled over the sleeping man, who awoke and immediately attacked him. The quarrel did not last long, the original occupant being left dead upon the floor of the car while the murderer quickly made his escape, leaving the village and neighborhood behind him as far and as fast as possible. An hour or two later the third man, seeking shelter and sleep, finds his way into the car, and dropping on the floor, is soon in a deep slumber. He awakes at break of day to find that a dead man has been his companion, and to see that his own sleeve is smeared with the blood of the victim. Alarmed by this discovery, and realizing in some degree the perilous position in which he is thus placed, he tears off the stained portion of his garment, and, hastily leaving the car, he flees from the scene as rapidly as possible.

Nothing can be more simple or more satisfactory than this account of the affair, and yet nothing is more natural than that he should be accused of the crime and brought to trial. The evidence against him was convincing, and it was all absolutely true. It was not strange, therefore, that his conviction and imprisonment should follow.

It will doubtless appear to many that the foregoing is too closely allied to the sensational to serve fitly as an introduction to an address prepared for a society of philosophers, and I am ready to acknowledge the apparent validity of the criticism. I am led to its selection, however, because it is an account of an actual occurrence, which illustrates in a manner not to be misunderstood a not unrecognized proposition to a brief exposition and partial development of which I ask your attention this evening. This proposition is that, in the treatment of many questions with which we are confronted in this world, our premises may be absolutely true and our logical processes apparently unassailable and yet our conclusions very much in error.

No department of human knowledge or region of mental activity will fail to yield ample illustration and proof of this proposition. An astonishingly large number of debatable questions present themselves to the human intellect. Many of them are conceded to be of such a nature that differences of opinion concerning them must continue, perhaps, indefinitely.

But there is a very large and a very important class of problems, the solution of which is apparently not impossible and often seemingly easy, regarding which the most diverse views are most persistently held by persons not differing greatly in intelligence or intellectual training.

Men whose business it is to weigh evidence and to reach correct conclusions, in spite of inadequacy of information and perversion of logic, constitute no exception to this statement, but, on the contrary, furnish many of its most notable illustrations.

Many of the questions which present themselves to our jurists and juries are simply questions of fact, and the testimony on which the determination of such questions depends often comes from persons who are neither interested nor dishonest. In such cases it ought to be easy to reach a true conclusion, but there is often failure, growing out of honest differences of opinion.

An eminent attorney not long since referred in conversation to a certain decision of the Supreme Court of the United States concerning which there had been a strong dissenting minority. The question was one which involved neither passion nor politics, and he declared that to him it seemed utterly impossible for a disciplined mind to reach other than one conclusion regarding it.

In any review of this subject, such as is here suggested, it is neither necessary nor proper to refer to the numerous instances of utter failure in our judicial system, attributable to a lack of integrity on the part of those who administer the laws or to the mischievous results of appeals to passion or prejudice by unprincipled advocates. It is sufficient to recognize the fact that failure in the administration of law is not uncommon where witnesses are honest, juries intelligent and well-meaning, and judges incorruptible.

The rapidly increasing number of controversies within the church, to say nothing of those in which the disputants are on opposite sides of the wall, show conclusively that the logic of the theologian must sometimes go at a limping gait. In political or social economy there is great diversity of opinion among good and able men. Certain financial legislation by Congress is honestly thought by many people to be necessary to prevent widespread disaster and the financial ruin of one of the largest and most important classes of our citizens; by other equally intelligent and equally honest men such action on the part of the National Legislature is condemned as dishonest in principle and sure to be fatal to the business interests of the country.

A large number of able and patriotic men address themselves to the solution of the problem of the adjustment of duties upon imported merchandise. All have access to the same store of experience; the discussions and investigations of the past are open to all alike. In the end, however, their conclusions, even as to elementary principles, are diametrically opposed to each other.

But I have neither the time nor the disposition to enter into an exhaustive examination into the miscarriage of logic in the regions of politics, religion, or social science. I must restrict myself to some consideration of the uncertainty of conclusions reached by what may be broadly included under the general term "the exact sciences," a division of the subject not unlikely, I hope, to be of some interest to members of this society.

At the threshold of the investigation we are confronted by the term "exact sciences," and it is of the utmost importance to reach a clear understanding of the meaning of this phrase, in the beginning. By some writers its application is limited to the mathematical sciences or substantially to pure mathematics. This does not seem, however, to be in accord with the general usage among scientific men, and a wider significance will be here given to it.

Pure mathematics may, and possibly must, be regarded as a mode of thought; as symbolic logic; as an abridgment of mental processes by the selection of that which is common to all, and its formal expression by means of signs and symbols. Intellectual operations which, on account of their complexity and length, would be possible only to a few of the highest capacity are by the aid of mathematics brought within the range of the many. In virtue of the simple and beautiful nomenclature of the science, one can see at a glance, in a formula or equation, the various relations, primary and secondary, direct and implied, which exist among the several magnitudes involved, which, if expressed or defined in ordinary language, would be beyond the understanding of most intelligent people.

The principles and rules governing mathematical operations have been, in the main, so well worked out and so universally agreed upon that in mathematics one can hardly go astray, at least not without the certainty of almost immediate detection and conviction at the hands of many skilled in the use of this wonderful intellectual device. When dealing with quantity in the abstract, or with matter under just such restrictions or possessed of just such properties as are prescribed, mathematics becomes a machine of certain performance, the output of which can only be in error through the conscious or unconscious mistakes of the operator. As such it challenges the admiration of all, and it must forever be regarded as among the first, if not, indeed, the very first, of the few really splendid creations of the human intellect. When Plato, in reply to a question as to the occupation of the Deity, answered, "He geometrizes continually," he emphasized the dignity and the incontrovertibility of mathematical reasoning.

It is no reflection, then, upon the importance and value of the science of mathematics to leave it upon the pedestal which it rightfully occupies, considering it as separate and apart from other sciences. In their development it may and does play a most important part, in which, however, it is identified rather with the investigator than with the subject investigated; for, in studying the elementary principles of abstract dynamics, one may follow the now somewhat antiquated and cumbersome processes of Newton or the more simple and elegant methods of Clifford or Maxwell, but the results will in all cases be the same.

Before finally dismissing the pure mathematics, however, especial attention must be invited to one or two principles involved in their application by way of contrast with the condition of things which exists in the domain of the other sciences. It is sometimes declared by way of a criticism of mathematics that "what comes out of it is never better than what goes in." In a certain narrow sense this is true, but in a broader and truer sense it is as false as it would be to say that grain and fruit are no better than the soil from which they spring.

The mathematician has the great advantage over the physicist, the chemist, or the geologist that he not only can, but almost necessarily must, completely define the elements with which he has to deal. If he deals with matter, before he can put it into his equations he must needs restrict it as to form and dimensions and endow it with definite physical properties, the relations of which are capable of analytical expression. If, after this, his power of analysis is sufficiently great, the conclusions which he reaches can have no element of uncertainty in them, provided always they are considered as referring only to the supposititious material with which the investigation was begun. That the conclusions are not in harmony with known phenomena is evidence only of the fact that the material of nature is not the material which is symbolized in the formula, and that certain properties which are common to both are modified in the former by the presence of others which are not attributed to the latter. When MacCullagh, Neuman, Stokes, Sir William Thomson, or Max-

well, each evolves a dynamical or mechanical theory of light, a lack of agreement among them or with known principles of optics can generally be traced to the fact that the medium in which they suppose the action to take place has not been endowed with the same common properties by all, and that in every case it falls short of an exact representation of the real ether itself. With this important restriction upon mathematical reasoning kept continually in mind, mathematics may be safely set aside as the "one science of precision."

What, now, are the characteristics of the so-called "exact sciences" other than pure mathematics? Without attempting a rigorous definition or a precise classification, it is sufficient for the purpose at hand to declare that the exact sciences are those whose conclusions are capable of being, and for the most part are, established by experiment and verified prediction.

Among these exact sciences the most notable, in degree of exactness, is the science of astronomy. Although the conclusions reached in the study of astronomy may not in general be established by experiment, the marvellous accuracy with which its predictions are verified has long ago placed it far in advance of other sciences. An inquiry into the cause of this excellence will not show that the logic of the astronomer is any more rigorous than that of many others engaged in scientific research, but rather that the premises on which he reasons are simpler, and, what is of greater importance, more nearly sufficient. Until a very recent period in its history, astronomy, although dealing with matter, has been concerned almost entirely with only one of its many properties. The one property thus far assumed to be common to all matter is that long-known but still mysterious attraction in virtue of which there exists a stress between every particle and every other particle in the universe, according to a law the discovery and exposition of which justly entitles Newton to be considered the greatest philosopher of all ages. It happens that the hundreds and possibly thousands of other properties possessed by, or inherent in, matter have little if any influence on the dynamics of masses widely separated from each other, and therefore a knowledge of the law of gravitation seems to be sufficient to enable the astronomer, having, of course, obtained the necessary data from observation, to trace the paths of the planets and to foretell the configuration of the heavens many years in advance. Within the past twenty-five years, however, the splendid discovery of spectroscopy, aided by great improvements in photography, has given rise to a new astronomy, known as physical, as distinguished from gravitational astronomy. The new science deals with a matter of many properties, some of which are but little understood. While its conclusions are of vital importance and of intense interest, they result from deductions in which the premises are insufficient and are proportionately uncertain. The new astronomy must for a long time abound in contradictions and controversies, until, and largely through its development, we shall possess a knowledge of the properties of matter when subjected to conditions differing enormously from those with which we are now quite familiar. Because one astronomer declares that the temperature of the sun is 20,000° F., and another, equally honest and capable, says it is not less than 20,000,000° F., it must not be inferred, and it never is, except by the superficial, that the whole science of solar energy is a tissue of falsehoods, and that those engaged in its development are deliberately planning an imposition upon the general public. Even such widely varying results as these may be based on observations that are entirely correct and experiments that are beyond criticism. The discussion of the results obtained by observation and experiment may follow, in both cases, the very best models, and yet the conclusions may be erroneous and contradictory, owing to the insufficiency of data in the beginning.

Unfortunately the omission of one or more important quantities from the equations of condition is not always known or suspected. The older, more exact astronomy is occasionally caught tripping in this way. An interesting example of recent occurrence is to be found in certain observations for stellar parallax made a few years ago by members of our own society. The observations were long continued, the instruments used were of a high character, and the observers were skilful. These conditions unquestionably promise success. It was something of a surprise, therefore, when a reduction of the observations gave for the parallax a negative result. As such a result could in no way be possible, except, perhaps, through the assistance and intervention of a curvature in space (in virtue of which if a man's vision was not limited he would, by looking straight forward, see the back of his own head), it was assumed that the work was not as well done as it seemed to be, or that some imperfection in the instrumental appliances had been overlooked. It now appears, however, that this record may be reopened, and that the results may prove to be of as great value as originally anticipated. Researches carried on during the past year or two have with little doubt established the fact that the latitude of a point on the earth's surface is not a fixed quantity, but that on the contrary it varies through a small range during a period somewhat greater than a year. It is believed that if this hitherto unsuspected variation be applied to the parallax observations, referred to above, the seeming absurdity of the result will vanish.

If astronomy, the foremost of the exact sciences, is not free from the fault of basing conclusions upon insufficient premises, it will not be expected that among other sciences the evil will be of less magnitude.

When we consider the sciences of heat, light, electricity, magnetism, and other specially investigated properties of matter, all of which are usually included under the general head of "Physics," we meet with a formidable rival of astronomy in the extent to which they are entitled to be considered as exact sciences.

Physics treats of all the properties of matter, not omitting that which is the special domain of astronomy. As if this were not enough, the demands upon the science are such that it must also deal with that which is not matter, or, at least, is not matter in the ordinarily accepted sense. Although physics deals with all of the properties of matter, no physicist knows them, or, possibly, half of them. Perhaps not one of them is entirely and completely known. It would seem, therefore, that this science must of necessity be one of uncertain conclusions. That it is far from deserving so sweeping a criticism is due to the fact that the properties of matter are not so closely interrelated as to make it impossible to isolate one or more of them in experiment, and thus the problem is vastly simplified. It is probably impossible to do this rigorously in any case, so that there must always remain a small residuum of uncertainty due to the interference of unknown or imperfectly understood properties of matter.

Thus it is possible to treat a mass of matter as though it possessed mass only, ignoring its electrical, magnetic, or optical properties, its relation to heat, its elasticity, and other

physical characteristics, and investigate its behavior under the law of gravitation alone; its optical properties may be found to be nearly independent of its relation to heat, electricity, magnetism, etc., and so, in turn, each characteristic may be studied alone and equations obtained in which the number of constants is comparatively small. It is only after this plan has been pretty thoroughly worked out that it becomes possible to investigate the interrelations of these various properties, which are often obscure and difficult of detection. Their discovery, however, especially one or two great generalizations pertaining to them, such as that of the conservation of energy, must be regarded as the grandest triumph of physical science.

The science of physics is that which is most drawn upon in the formation of the so-called applied sciences. Wedded to mathematics as it is (and no amount of personal abuse on either side can ever furnish good reason for divorce), it becomes the mother of engineering in all of its various forms. Through and by it, the forces of nature have been directed, the elements have been subdued and some of them overcome, and man has made himself master of the world. Its marvellous progress has, therefore, been observed by the people, and is understood by them perhaps to a greater degree than that of any other science. The most eloquent orators and the ablest writers have employed their genius in sounding its praises.

It is not too much to say that when intelligent people speak, in a general way, of the wonderful things which science has accomplished during the past half-century, they have in mind, for the most part, the applications which have been made of discoveries in physical science. I think no one can justly question the assertion that of the several causes which have produced the splendid advances in the material interests of the whole world during the nineteenth century, science has contributed far more liberally than all others. So remarkable have been her achievements that all the people have come to look upon her as being nearly, if not quite, infallible. A reputation of which the votaries of science may be proud has been established, but, at the same time, one difficult to maintain. Here, as elsewhere, it is a good name only that is worth counterfeiting. It is quite worth the while of one devoted to the interests of pure science alone to occasionally inquire whether an impure article is not being placed upon the market. However indifferent he may be to the welfare of the general public, his own selfish instincts should incline him to such a course. He cannot clear his own skirts by declaring that the public deserves to be humbugged if it permits itself to be, for in this, as in everything else, the counterfeit when successful is not readily detected, and it is often made to appear more attractive than the genuine article.

In respect to this matter physical science presents two aspects. In a large degree it is a science of certain conclusions, and any false deduction is readily exposed by means of the many severe tests to which it may be subjected. On the other hand, in some of its branches it has not yet been found possible to isolate the elements which form a rather complex whole, and it therefore remains an observational rather than an experimental science. In the latter aspect it becomes comparatively easy prey for charlatans and well-meaning but ignorant non-professionals.

In no department of physical science is this better illustrated than in meteorology, the oldest and most abused of all sciences. From its early days, when weather forecasts were expressed in simple rhyme, to the present, when they are issued in a prose which in its scope and richness of vocabulary sometimes excites our highest admiration, meteorology has been a favorite victim of pretenders, conscious and unconscious. For years the people, after having first believed in, have patiently borne with, the predictors of disaster in the form of abnormal meteorological disturbances. They have suffered great mental distress, and they have lost enormous sums of money on account of floods, tidal waves, and earthquakes which never came, rains that never fell, and winds that never blew. They were becoming accustomed to this sort of thing, and were beginning to understand the spirit which guided the real meteorologists as manifested in the efforts of the great weather bureaus of the world, our own among the first, to foretell with a good degree of certainty what might happen within the next twenty or thirty hours. But not many months ago they were again brought to a high pitch of meteorological excitement by the somewhat sudden and certainly unexpected appearance of the "Cloud-compelling Jove." He came not in the singular, but in the plural, and each of him brought the best and most scientific device for producing a rainfall whenever and wherever a sufficient thirst was found to exist. The history of this new industry cannot yet be written. It is still in its infancy. The fallacy of its methods has already been commented upon in a public journal, by a distinguished member of our own society, but a few remarks upon its somewhat meteoric career during the past season will not be out of place in connection with the subject now under consideration.

The columns of the daily press reflected the general interest which was felt in the matter, especially in parts of the country where rainfall was greatly needed. As is always the case under such circumstances, the strong and entirely natural desire that its artificial production might be accomplished was soon converted into a belief that it had been, and a readiness to accept the flimsiest sort of evidence of relation between the means employed and the end sought. This confidence materialized, or better, perhaps, was taken advantage of in the formation of an "Interstate Artificial Rain Company, Limited" (I am quoting from the daily papers of Nov. 10, 1891), which, after the manner of its kind, was apparently organized not for the purpose of actually producing rain, but for the formation of other joint-stock companies ready to purchase the secret method of doing it. An alleged experiment, on which a business transaction was based, is thus described: —

"The party arrived in the city on Sunday, Nov. 1, and commenced operations on Sunday evening in a small outhouse on the edge of town. The conditions were extremely unfavorable for rain. No results could be seen at first, but on Friday the sky became overcast with clouds. On Saturday a high south wind prevailed, and on Saturday night some rain came from the south-west. On Sunday rain fell all day, and at night a norther arose. Reports from 100 to 150 miles around this town show that rain fell on Sunday in most localities in considerable quantities." So convincing was this to the buying company that the secret process was purchased by them for the sum of $50,000, "after which," the account rather unnecessarily adds, the selling company "left for home." But a business so profitable as this was not to be long without competition, and a few weeks later a telegram is sent to the leading newspapers of the country, announcing that a professor in a western State (it is pleasant to note that most of these public benefactors are "professors") is prepared to furnish rain more promptly and at less cost

than the genius whose machinery and methods have invited public approval. Proposals to do the county sprinkling at so much per acre are invited and offered, and at one time it seemed as if the whole business would be ruined by overproduction.

One of the most interesting phases of this subject was the attitude in reference to it assumed by a large part, possibly the greater part, of the intelligent public. It was one of expectancy and limited confidence. "Why not?" was commonly asked. "Look at what science has done within the last twenty-five years. Can anything be more astonishing? and is the artificial production of rainfall more difficult and more wonderful than many things which are now commonplace?" To many the logic of the experiments was convincing. After many battles rain had fallen, long lists of examples have been prepared, and hence it must be possible to produce rainfall by cannonading. If these views were entertained by a considerable number of intelligent people, and it is believed that they were, the situation is one which ought to be full of interest to men of science, involving, as it does, both a tribute and a warning.

It would be good for all if the intelligent public was in the habit of looking a little more below the surface of things. It is too much in the way of assuming that the president of the company engaged in exploiting an important invention or device is the genius who first discovered the principle in virtue of which it operates. It loses sight of — no, it does not lose sight of, because it never knew — the patient toil, the unselfish devotion, and, what is perhaps more important, the unflinching honesty with which a few men of the highest intellectual capacity have from the earliest times given themselves to the study of the laws of nature.

It would surprise the public to know how long ago and by whom many of the most recent and most brilliant applications of science were made possible. Would it not be in the interest of all if men of science were more ready and willing to take the intelligent public into their confidence; and would not the public, if familiar with the history of scientific investigation and accustomed to scientific modes of thought and criticism, be less the prey of charlatans and well-meaning but ill-informed enthusiasts? A better knowledge on both sides would lead to a better appreciation of both sides, and the real worker in science would seldom go without that public recognition which has too often been denied to the ablest men. No better illustration of this can be found than in the life of the distinguished first president of this society, to stand in whose place must always be an honor to any man. With his great work as secretary of the Smithsonian Institution the public is fairly well acquainted, and it has not been backward in bestowing honors in recognition of that work. Unfortunately, comparatively few know of what must be regarded, I think, as his greater work, the original researches in which he was engaged, and in which he was so singularly successful, before he became identified with the institution to which he gave the greater part of his life. Scant justice has yet been done to this important part of a career which must always be an inspiration to members of this society.

But I am warned that the brief time during which I can claim your attention to-night is quite insufficient for anything like a full exposition of the theme which I have selected, and I must, I fear, somewhat abruptly turn about in order that I may leave with you in somewhat more definite language one or two thoughts which I have attempted to develop by illustration and example.

Recurring to the unfortunate victim of circumstantial evidence, whose experience was related in the beginning, it will be admitted that the judge who charged, the jury who convicted, the witnesses who told the truth, and the approving public were all in error, in that they failed to recognize that there was another way of explaining what had happened. It does not necessarily follow that the explanation which explains is the true one. There are many natural phenomena which are in entire accord with more than one hypothesis. Indeed, there are some things which may be perfectly accounted for on an infinite number of suppositions, but it does not follow that all or any one of them must be accepted. There is nothing especially novel in this proposition, but I submit that to a failure to keep it in sight must be attributed a large measure of the uncertainty of the exact sciences, as well as much useless and bitter controversy in science, religion, ethics, and politics.

As a sort of corollary to this proposition I suggest that many reasoning and reasonable people are indifferent to, if not ignorant of, the fact that the value of evidence is greatly dependent on the way in which it arranges itself. To many this may be made a little clearer if I borrow a phrase from one of the most exact of modern sciences and speak of evidence as presenting itself in series or in parallel. Without pushing the analogy further, the superior strength of the latter arrangement will be evident upon reflection. On another occasion, I have referred at some length to the numerical representation of the value of testimony, and to some conclusions which are easily reached. As bearing upon the subject in hand, a single example of this method of treatment may be useful.

Let there be two witnesses, A and B. Suppose that A tells the truth 51 times out of 100; that is to say, assume that honesty holds the controlling share in his stock of moral principles. Let B be equally truthful and no more. Then if these two testify independently to the occurrence of a certain phenomenon it is more likely to have occurred than if either one alone bore witness. This is evidence in parallel. If, however, A testifies that B declares that the thing happened, it is less probable than if based on the testimony of either alone. This is evidence in series. Put as boldly as this, no one doubts the higher value of the first arrangement; but it is believed that a more careful consideration of this distinction will do much to secure a better judgment, not only where human testimony is involved, for here it has long been an established principle, but where conclusions are based on observation and experiment.

It is of the utmost importance, therefore, that men of science, before accepting a theory or a hypothesis as final, should carefully scrutinize the steps by which it has been established to see that they are not only sufficient but necessary. The true philosopher will be slow to claim that the theory which he finds sufficient to explain all of a given class of facts is the necessary and true one; he will be constantly on the lookout for a new fact which his theory will not quite explain, and he will have much consideration for his friendly competitor who finds a different hypothesis equally satisfactory and efficient. Above all, he will not pride himself on the steadfastness of his views, and will rarely bind himself to be of the same opinion this year as last.

If the general public could be made to understand the limitations by which science is circumscribed, the tentative and ever progressive character of scientific investigation, it would be good for the public and good for science.

The human race is greatly handicapped by the presence of a good number of people who strenuously object to being disturbed. During a decade, generation, or century these good but sometimes unpleasant people plant themselves along certain lines in the domain of science or politics or religion, proclaiming essentially that "here and here only is the truth, and here we fix ourselves forever." After awhile they somewhat unwillingly and with no very good grace move forward into a new position, again honestly affirming and believing that the end has been reached. A better knowledge and a broader human sympathy would reveal to them the hitherto unsuspected fact that truth may at the same time be here and there.

In the dissemination of this knowledge and the cultivation of this sympathy, science should lead, not follow. No scientific organization so young in years has done more along these lines, especially by reason of its extensive membership and the vigor and enthusiasm of its branches, than the society over whose deliberations during the past year I have been permitted to preside.

For the honor thus bestowed I beg now to make my formal and grateful acknowledgements.

REMARKS UPON THE GRAPHIC SYSTEM OF THE ANCIENT MAYAS.

BY HILBORNE T. CRESSON, A.M., M.D.

A MAYA hieroglyph may be a single character by which a meaning is expressed by the sound of the name of the thing represented, or it may have a number of components that convey by a similar method a series of ideas. The 'glyphs of *Kukuitz* and of *Cauac* in the Codex Troano are examples, and another is that over the figure of *Kukulcan*, or *Ikilcab*, the so-called long-nosed god, of whom representations appear so frequently in the different Maya codices.

The figures of gods, with their head-dresses and the objects represented by the Maya scribes in the Codex Troano and other manuscripts, may be composed of a series of hieroglyphic elements suggesting the names of gods and their attributes or of some of the various characters which they impersonate. An example of this is the head-dress of the long-nosed god of the Codex Troano, which reads *Ikilcab*, while his girdle expresses by phonetic elements the name *Kukuitz*, who seems also to have been *Kukulcan*, *Ikilcab* or *Cauac*, and *Itzamna*. It is not improbable that *Kukuitz*, *Kukulcan*, *Ikilcab*, and *Itzamna* is the *Hunakbu*, or one God spoken of in the Codex Troano and referred to on the hieratic tablets, Casa No. 2, Palenque.

I notice that in the photographs of the ancient cities of Yucatan and other portions of Central America, that which we have hitherto considered as *architectural ornamentation* of *Maya design* is *ikonomatic decoration*, and a notable instance is the name *Chi-chen-itza* on the palaces of that ancient city, which are repeatedly recalled by *Chi* and *itza*, and less frequently by repetitions of the word *Chen*. I make this assertion subject to further alteration and improvement, as I have not examined the buildings themselves, being obliged to depend upon bad photographs and still worse wood-cuts.

The hieroglyphs and ikonomatic ornamentations of Palenque, *Chi-chen-itza*, Labna, Tikul, Lorillard City, and Copan, judging by photographs taken at these places, seem to be allied to one another, but those of *Uxmal* are more archaic, with the exception of Copan.

The plan I have adopted in my analysis of the various components of a 'glyph, those standing for the sounds of the names of the things represented, is based upon the idea that the Maya script, both hieratic and demotic, is similar to the higher grade of picture-writing suggested by M. Aubin, in his analysis of the name *Itz-co-atl*,— represented by the conventional sign for water, obsidian attachments to the shaft of the arrow, and a vase or pot,— which by reference to his work will more fully appear.

Proceeding upon this plan, I endeavored to analyze Landa's Key, and have found that the Maya scribe simply gave 'glyphs, whether simple or combined together, that carried out Landa's pronunciation of the Spanish alphabet, by means of characters which stood for the sounds of the names of these letters.

The hieroglyph of a tarantula or centipede, figured in the Troano plates — a claw pinching a rope attached to the foot of a deer-like animal, and also a band attached to the same insect-like figure in the act of pinching — suggested the various curved 'glyphs of the verb *C^hi* (Maya, to bite), which are, I believe, in connection with the parrot 'glyph, *Moo*, a part of the primitive elements of the Maya alphabet. From this I have obtained Chá, Chā (or Che), Chi, Cho, Chu, and from the *Moo* (parrot) 'glyph has been obtained a, e, i, o, u. This system has been applied successfully to the rendering of the components of the day-signs of the Troano manuscript and those of the Chilan Balaam of Káua, using Dr. Brinton's plates for the work — those published in his essay upon the books of "Chilan Balaam," pages 16 and 17.

In several cases certain 'glyphs, such as that of *Ikilcab*, *Cauac*, and *Itzamna*, have suggested meanings so clearly expressed that the words were easily found in the vacubulary of the Abbe Brasseur de Bourbourg, and had such a strong resemblance to objects and 'glyphs carried by the figures to which they belonged, that I venture to think the alphabet which I have arranged will eventually work successfully. It is based upon studies of the hieratic script made while at the Ecole de Beaux Arts in 1875–76–77, and work done on the Troano script in 1880; these researches being thrown aside and recommenced since Jan. 1, 1892.

Although Dr. Thomas and myself have proceeded in methods totally different from each other, and have never yet met to make comparisons, in quite a number of cases our methods have shown like results. I have mailed Professor D. G. Brinton, and the first-named gentleman, proof of this similarity of interpretation, and may also add that before I received a copy of Professor Thomas's "Key" I had mailed, and I venture to say both these gentlemen had received, my analysis and arrangement of the Maya signs of orientation, viz., *Chikin*, West; *Lakin*, East; *Schaman*, North; *Nohol*, South. My arrangement of these signs corresponds to that of de Rosny and Thomas. The first sign of orientation on the list was determined by the C^hi 'glyph.

I mention the correspondence of my work with that of Professor Thomas to show that this similarity of interpretation, referred to, cannot be the result of mere guesswork.

The aspirates and signs of repetition and the determinatives of the Maya Graphic System are most important, and I give them as Landa expresses it, and also by dotted lines in circles and curves. The phonetic value of the curve in the Maya alphabet is one of its strongest elements. Most of the characters in the key I have arranged are based on it and other natural suggestions of animate and inanimate nature—

such as the parrot eye, the biting mouth, and the mole-like teeth, the curved line of the serpent's body, and the beautiful outlines of the *antennæ* of the bee, also its sting, and last, not least, the graceful leaf of the maize, and other natural forms which are symbols of fertility.

It may be interesting to remark that the phonetic value of the *antennæ* of the bee was suggested by the third 'glyph, *Cauac*, on the *Kukuitz* bas-relief, left-hand side of the Casa No. 3, Palenque. This 'glyph was traced to more demotic forms on plate 25 of the Troano, also plate 24, where it is upheld by the Goddess *Cab*. Near the figure of *Cab* is the same infant-like figure that is to be seen on the so-called tablet of the cross of Palenque. The component characters of the 'glyphs composing this child's body refer to his name as *Ikilcab*, and this same name is expressed on the head-dress and hieroglyphs of the God-with-the-long-nose of the Troano, and other manuscripts, so-called by students to distinguish him. *Ikilcab* and *Cauac*, the *Cuch-haab*, are in some way clearly connected, for the components of the *Cauac* 'glyph of the day-signs of Landa and those of the Chilan Balaam of Kaua are closely connected with those of *Caban*. The *Cauac* 'glyph, if my interpretation be correct, reads *Ikilcab*. The ancient Mayas probably thought of the bee as *Ikil*, the sting, and *Cab*, honey. The 'glyph of the day-sign, *Caban*, refers to that day-sign and *Ikilcab*, and is also the honey sign ("Bee Keeper's Narrative," the Codex Troano). The numeral signs of the Troana, both red and black, seem to have been used at times ikonomatically. The serpent symbol on plate 25, division 1, Troano, is *C'an*, and close to it are numerals giving the suggestion *Hunakbu*, the one God. On the sun symbol of this plate are numerals, which, in connection with the flute 'glyph (*Chul*) projecting above the sun-disk and the hand below pinching the machete, suggest the interpretation "a name," *Chu-kul-ca-can*.

Alliteration and syncapation for the sake of euphony are especially noticeable in the Maya language, but do not seem to be followed in the arrangement of their graphic characters, and no regularity of procedure, in reading the component parts of a 'glyph, seems to exist. As a general thing, however, some object carried in the hand of a figure, or placed near it, serves as a sort of a determination or suggestion; this is more frequently the case in the demotic than hieratic script.

Publications Received at Editor's Office.

AMERICAN JOURNAL OF POLITICS. Vol. I. No. 1. 35 cents.
CHAMBERS'S ENCYCLOPÆDIA. Vol. IX. Philadelphia, J. B. Lippincott Co. Imp. 8°.
CRESSON, HILBORNE T. Report upon Pile-Structures in Naaman's Creek. Cambridge, Peabody Museum. 8°. Paper. 21 p.
NATIONAL POPULAR REVIEW. Vol. I. No. 1. San Diego, Cal., J. Harrison White. 25 cents.
ROYAL SOCIETY OF VICTORIA. Transactions. Vol. II. Part II. Melbourne, The Society. 4°. Paper. 51 p.

AMONG THE PUBLISHERS.

A SECOND revised and enlarged edition of a popular work on the tariff question, entitled "The Free Trade Struggle in England," by Gen. M. M. Trumbull, will shortly be issued by the Open Court Publishing Company.

— Charles L. Webster & Co. will soon issue a work by R. L. Garner, entitled "The Speech of Monkeys." This work embodies his researches up to the present time. It is divided into two parts, the first being a record of experiments with monkeys and other animals, and the second part a treatise on the theory of speech. The work is written so as to bring the subject within reach of the casual reader without impairing its scientific value.

— Ginn & Co. will publish at once "German and English Sounds," by C. H. Grandgent, director of Modern Language Instruction in the Boston Public Schools. The volume will contain a detailed account of the sounds that occur in German and English speech, a description of the principal local variations in the pronunciation of both languages, and a series of diagrams showing the positions of the vocal organs during the formation of the vowels and the more difficult consonants.

— G. P. Putnam's Sons have in press "Japan in Art and Industry," by Felix Régamey, translated by E. L. Sheldon (fully illustrated); "The Fairy Tales of India," collected and edited by Joseph Jacobs, who follows up his "Celtic Fairy Tales" of last Christmas and "English Fairy Tales" of the preceding Christmas by a selection from the gorgeous fancy of the East, illustrated by J. D. Batten; "Hygienic Measures in Relation to Infectious Diseases," comprising in a condensed form information as to the cause and mode of spreading certain diseases, and the preventive measures that should be resorted to — isolation, disinfection, etc., by George H. F. Nuttall, M.D., Ph.D., Associate in Hygiene and bacteriology, Johns Hopkins University and Hospital; "Temperament, Disease, and Health: an essay," by Com. F. E. Chadwick, U.S.A. (retired), and "Lyrics and Ballads of Heine, Goethe, and Other German Poets," translated by Frances Hellman.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
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Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
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Some of the Contributors to *Science* Since Jan. 1, 1892.

Aaron, Eugene M., Philadelphia, Pa.
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SCIENCE

NEW YORK, JULY 15, 1892.

THE CHEMISTRY OF SOILS.[1]

BY PROFESSOR R. ELLSWORTH CALL.

A SOMEWHAT extended experience in the chemical analysis of soils with a view to their agricultural value has led to certain conclusions which may not be altogether devoid of value to the readers of *Science*. Especially may this be true since there is often an entirely erroneous opinion among those most concerned respecting the useful deductions which may be made from a complete chemical analysis of a soil. Usually it happens that if only the presence of certain desirable substances be shown, then the value of the soil for the production of this or that crop is assumed to be definitely settled. Nothing could, in general, be farther from the truth. Of course, something definite may be said of such soils as those in which both sand and clays, or either, predominate, but the conclusions in these cases are based on the physical characteristics of the soils rather than on their chemistry. Indeed, it is usual to classify soils in two general categories, the classification being based, on the one hand, on the method of soil-formation, and, on the other hand, on its physical characteristics. The soils of Iowa belong, in the main, to that class which is based on the method of formation, and are composed chiefly of transported or drift materials. It is, however, true that the Iowa soils, though glacial, owe much to the physical characters of the rocks which they represent as disintegrated and far-travelled *débris*. The sands and clays are all transported materials, most of them from points many miles to the north of the prairie regions which they now cover. It is, moreover, clear that no degree of coarseness or of fineness, which may result from the methods of origination of any soil, constitutes in itself sufficient ground for saying this soil is fertile or that soil is unsuitable for plant growth. Recourse must be had to the ultimate composition of the sample, and right here enters an element of error against which, popularly, it is difficult to guard.

The physical character of a soil or marl must be considered when studied chemically. The finer the condition of the sample, in nature, the more readily are induced those changes in its chemistry which result from atmospheric influences. That is to say, when coarse and fine soils are treated alike mechanically by the plow, the one may become mellow and well mixed, while the other is broken without being well mixed or turned. Now, the chemical processes which occur are most active and most complete in soils that are fine in texture. It follows, therefore, that a stiff, clayey soil may contain all the essential elements of the food of any plant, but be in such condition physically as to render the chemical processes difficult of operation. And, on the other hand, such a soil may be sufficiently fine, but the well-known tendency to "cake" or harden on drying or exposure would render it valueless agriculturally, no matter how finely comminuted its materials may be.

[1] Extracted from the Monthly Review Iowa Weather and Crop Service, Vol. III., No. 5, May, 1892.

Clayey soils, again, do not permit that free, subsoil circulation of water so necessary to growing crops. Circulation there is, but it is limited at best; open, porous soils admit free, underground water-flows, but such soils soon dry. They lose large quantities of water through evaporation, due to the rather free circulation of air in the upper portions of the cultivated areas.

Color, too, has little to do with deciding finally whether a soil will be fertile. Usually all earths which are dark-colored or black—a condition largely due to the amount of carbonaceous material derived from decayed vegetation—are considered fertile. It is true that common consent places all such samples among the fertile soils, but it by no means follows as a necessary deduction. So, too, that light drab or ashy-colored soils lack the elements of fertility is a notion which observation and experiment alike negative. The most fertile of Iowa soils is the loess, a peculiar and very fine marl covering many hundred square miles along the Mississippi and Missouri rivers, as well as the higher lands along the Des Moines. It is a soil the color of which would condemn it for agricultural purposes, but it is one which is of exceptional value for all sorts of cereals, and is peculiarly adapted to the growth of fruit. It is finer in texture than is any other soil in the State. What, then, constitutes its peculiar feature, rendering it so valuable? The answer to the query lies almost solely in its physical condition, which is of a fineness equalling that of any clay. This fine condition renders it admirably suited to the action of native chemical agents. These are the real soil-makers. Soils that plants may use must be soluble, and one of the essentials to complete solubility is fineness of the constituent particles. A certain and definite relation to moisture must be established and maintained, a condition which is practically reached by under-draining soils of a clayey nature. Too much water will compel adhesion of the smaller particles, and the product thus formed be eventually coarse and lumpy. Such a soil may be very fertile, but is not arable. This is the condition of most of the bottom lands of eastern Arkansas, the soils of which region are deficient in lime alone of all the ingredients which plants require. They are "wet and cold," and cannot be under-drained. Few soils of this nature occur in Iowa.

To make a long story short, chemical analysis of any given soil will determine its probable agricultural value only within very wide limits, and for reasons which appear below. It may be said, at this time, that such an analysis may determine one of two things, (*a*) the presence or absence of constituents which the plant must have, or (*b*) the presence of some substance which will affect injuriously a growing plant. The chemical laboratory will never supplant the province of carefully conducted experimental agriculture. But it may become a most valuable adjunct to the operations of the farm. The principles which underlie agricultural chemistry need only to be understood to be appreciated by those who have the manual labor of the farm to perform.

Aside from these general considerations there remain yet others to which it will be well to advert.

One of the great difficulties in the way of an intimate knowledge of the relations of plants to soils lies in our ignorance of the laws of assimilation in the plant. The conditions under which the chemist studies these are of necessity artificial. He cannot be assured that he has even measurably reproduced the conditions of nature, and hence cannot be sure that similar results will be attained under such most natural conditions. Those most complex and peculiar changes which occur in chemical compounds under what, for want of a better term, are denominated "vital forces" can never, at least under the present limitations of knowledge, be fully understood. And right here is the gist of the whole matter. A knowledge of the chemical constitution of a soil must precede a study of its relations to the full or incomplete, as the case may be, development of a plant dependent on it for nourishment. In other words, the constitution of a soil is a determinable quantity, the life-processes of the plant constitute an indeterminate quantity, and the relation of the two is the thing sought. No amount of chemical experimentation can bring into view the unknown factor.

The various experiment stations which are now established in every State in the Union can do much toward clearing away a great cloud of agricultural superstition relative to these subjects. There should be place for the theoretical as well as the practical in their work. It should be clearly shown that the constitution of a soil has far more to do with the growth of a crop of corn than the moon, or than any other of the oft-quoted and still entertained notions of strange and hidden forces. Tall oaks do not grow from little acorns except under the most favorable conditions of soil, and these conditions, again, are affected by the innumerable changes which occur in temperature, moisture or other variables, which render more or less tractable the various compounds on which the plant must feed.

The chemist who studies a soil does so by the same methods as those by which he would examine an unknown mineral, and usually with no greater care. He wishes, simply, to know what elements may occur in it, under what conditions, in what abundance, to what degree they may be dissociated, and whether there be present any substance which would interfere with their assimilation by the plant. In this way he arrives at a fair knowledge of the sample, but he can tell you little of its value for agricultural purposes. He here depends not on his knowledge of soil constitution or of its genesis, but on the facts of observation, which are familiar to every farmer, and which he unconsciously connects as cause and effect. It does not need a chemist to tell an observant farmer that he will not be likely to reap a strong growth of wheat from a sandbar. He has had as an instructor an experience in the relations of crops to the labor expended on them that led him to definite and valuable conclusions on this matter. But there are innumerable questions which he may put to the chemist and hope for a profitable answer. When once the soil has been exhausted of a necessary constituent he may learn from experience that this or that material judiciously applied will remedy the defect. The farmer, moreover, has yet to learn that, even in Iowa, there cannot be a constant draft on a soil and the same crop be produced with equal value each year for an indeterminate number of years. Each crop lessens the productive power of a soil by the amount of material which it removes from the soil each season. Here it is possible for the chemist to aid the producer by telling him exactly what has been taken from th[illegible] l thus indirectly telling him what is needed in the compost he may apply. This borders on organic chemistry and does not at present concern us.

Among the substances which must be present in a soil to give it an average degree of fertility stands pre-eminent the compound known as phosphoric acid. But this substance does not exist in the soil except in combination with some other substances, known technically as bases. These substances are commonly, if not always, iron and alumina, with which they are in such chemical combination as to form salts known as phosphates. It is, however, not sufficient to know that these compounds are present. We must further know whether they are so associated with other compounds as to be readily disintegrated and rendered soluble, for unless soluble they cannot be used as plant-food. Now, neither of these compounds of phosphoric acid — *i.e.*, iron and alumina phosphates — is available in that form. Experiment has shown that the form in which these substances are available is that of calcium (lime) phosphate. That this has a relation to the amount of calcium silicate in the soil is clearly proven, and that by a process of double decomposition of the three compounds the available one is obtained is also well known. But this process has not yet been certainly traced in nature. As stated at the beginning, it is right here that the processes of the laboratory and those of nature need to be connected. Whether they ever will be depends upon the support given to the great army of practical chemists whose attention is now directed to the theoretical features of agricultural chemistry.

It should be a matter of congratulation to the farmers of Iowa that work along these lines is now progressing very favorably at the experiment station at Ames. A vast amount of valuable information may be expected from this source, and in due course of time it will come.

CURRENT NOTES ON ANTHROPOLOGY. — X.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The Ancient Libyan Alphabet.

IN *Science*, May 8, I called attention to the new light thrown upon the history of our alphabet in its ancient form by the researches of Dr. Glaser among the ruined cities of Arabia. Another curious study in the same line is that offered by the Libyan alphabet. It appears to have been in common use among the Berber tribes of North Africa long before the foundation of Carthage, and is still employed constantly by the wild Touaregs of the Sahara. It is not the same as the Iberic alphabet of Spain, and in its forms is almost entirely independent of the Phœnician letters. It is composed of consonants, called *tifinar,* and vowel-points, known as *tiddebakin.* The latter are simple dots, the former are the lines of a rectangle, more or less complete. Several of them are found in the oldest Etruscan inscriptions, and on that known as the "inscription of Lemnos." Sepulchral epitaphs in this alphabet have been discovered dating two or perhaps three centuries before the Christian era; while rock-inscriptions of perhaps more ancient date, showing extremely archaic forms of the letters, have been copied from localities in the southern Atlas ranges.

The writers who have given especial attention to this little-known subject are Faidherbe, Duveyrier, Halevy, Bissuel, and, recently, Dr. Collignon, who has a brief summary of results in a late issue of *Les Sciences Biologiques.*

The Aborigines of Asia Minor.

The artistic and linguistic studies into the proto-ethnology of Asia Minor (see *Science*, May 20) are happily supple-

by the investigations of Dr. F. von Luschan of Berlin, on the Tachtadschy of Lycia, published in the *Archiv für Anthropologie*. This *nomen gentile* is not ethnic, but means merely "wood-choppers," or "board-makers." It is applied to a shy, secluded people, who live in the mountains, and fell and dress trees as their main business.

On measuring them, Dr. von Luschan found that they had unusually short and high skulls,— hypsi-brachycephalic, —and were of small stature, with dark hair and eyes. Comparison with some skulls from very old Lycian graves, and with part of the present population of Armenia and other portions of the region, led him to the conviction that in this type — so markedly distinct from that of the Greeks and Semites — he had before him the original of the most ancient population of the land. He considers it certain that it extended over the whole southern half of Asia Minor; north-east to the Caucasus; east to the upper Euphrates; but its northern and western limits are not yet defined. He even hints that the short, dark, brachycephalic people of central Europe may be the western extension of the type.

As to whence it came, he is not without an opinion. Not from Europe, not from Africa, not from northern Asia, not from southern Asia; all are excluded for sufficient reasons; central Asia alone is left; and somewhere in that mysterious *matrix gentium* he expects will be found the ancestral connections of this well-marked type. There, then, we should search for the linguistic analogies of the Cappadocian words quoted from Professor Tomaschek in my previous article. It would be a brilliant corroboration of a purely physical study in anthropology to discover such analogy.

Work of the Eleventh Census Among the Indians.

It is not generally known — in fact, it is pretty hard to find out — how much excellent anthropologic material is annually collected and in part published by the various departments of our central government. The army, the navy, the surgeon-general's bureau, the Smithsonian, the National Museum, and the specially-created Bureau of Ethnology, all pour forth every year quantities of valuable observations.

Nor has the Eleventh Census been behind in this good work, as is testified by the "Extra Census Bulletin," just out, on the Six Nations of New York. It is but the fore-runner of a series of such Bulletins on the remnants of our aboriginal population, and is an excellent earnest of the merits of its successors.

The aim of these bulletins is to supply first-hand and accurate statements of the present social, religious, industrial, vital, and political condition of the tribes: in other words, they are ethnographic, in the right sense of the term. The general editor is Mr. Thomas Donaldson, and in this instance his collaborator is General Henry B. Carrington. A large quarto of 89 pages, well indexed, with maps and photographs, gives a most satisfactory account of the present status of the Cayugas, Mohawks, Oneidas, Onondagas, Senecas, and Tuscaroras. The action of the Census Bureau in this direction is the more welcome, as in the rapidly changing condition of the native tribes, not many censuses will have the material with which to occupy themselves in this direction.

The Extension and Study of the Nahuatl Language

If we may judge of the superiority of a language by its vitality, and by the impress it leaves on others with which [illegible] in contact, we must assign a high place to the [illegible] or Nahuatl. It is still spoken in comparative purity by considerably over a million people, and it has made a deep impression on the Spanish of most of the Mexican and Central American States.

For Costa Rica, this has been shown in a work issued in the present year at San José de Costa Rica, by Señor Juan Fernandez Ferraz, formerly inspector-general of education in that republic. It is entitled, "Nahuatlismos de Costa Rica," and is a neat octavo of about 150 pages, with an introduction on Nahuatl grammar of 75 pages. The alphabetical list shows that a large number of terms in the current speech of Costa Rica, which have assumed the form of Spanish words, are derived from the Mexican tongue.

A similar work for Nicaragua, written by the late Dr. C. H. Berendt, is now preparing for the press under the efficient editorship of Dr. K. Lentzner of Berlin. The Nahuas, or a colony of them, once occupied a considerable tract on Lake Nicaragua, and left the marks of their occupancy not only in interesting ruins, but on the language of their conquerors as well. It was in this Nahuatl-Spanish dialect that the comedy of Gueguence was written (published in Philadelphia, in 1883).

It is agreeable to note in this connection that the study of the Nahuatl finds zealous advocates in Mexico, among whom the names of Peñafiel, Palma, Hunt y Cortes, Altamirano, Caballero, and Rosa, hold conspicuous places.

Anthropology at the Columbian Exposition.

Anthropology does not appear by name at the Chicago "World's Columbian Exposition." This is to be regretted, as it is a fine opportunity lost to inform the people of the United States what this grand science is, and how its several branches stand related to each other.

It is represented, in fact, in "Department M," with a most competent chief, Professor F. W. Putnam of Cambridge. A descriptive pamphlet of this department which has just been issued announces that it includes "Ethnology, Archæology, History, Cartography, Latin-American Bureau, Collective and Isolated Exhibits,"— rather a miscellaneous stock. It is further stated that there will be a section on physical anthropology and an anthropological laboratory, which are classified as a subdivision under the section of ethnology. In spite of these defects in classification, no doubt abundant and excellent material will be provided for the student, which he can work up in his own way. A correspondent in Berlin informs me that Dr. U. Jahn, who has charge of the matter there, has prepared, among other things, a series of specimens of German houses of all varieties, to be erected at Chicago, and in one of them, the *rathhaus*, he will arrange a complete exhibition of ancient and modern German costumes, domestic utensils, home manufactures, etc. The sections at Chicago on Folk-Lore, Games, and Primitive Religions will be under the supervision of Stewart Culin Esq., of Philadelphia, who has lately been appointed General Director of the Museum of Archæology attached to the University of Pennsylvania.

NOTES AND NEWS.

VERY numerous experiments have been recorded to show that moisture is saved by cultivation. Frank E. Emery of the North Carolina Experiment Station says: "During this hot, dry weather every foot of plowed land should be kept well stirred on the surface with any tool which tends to keep it from baking. A loose, fine surface will hold down water like a wet blanket. A field kept thus may give an increase in crop over one not cultivated equal to that produced by a heavy application of fertilizers. Preservation of the soil-water thus becomes of great importance. A

blanket of fine soil on the surface during a hot, dry week can be of great value to the crop and really become the turning-point for profit if present when loss might result from its absence."

— The North Carolina Experiment Station has just published a 26-page Bulletin (No. 84) dealing with the fungous and insect enemies of garden and truck crops. The trucking interest has become one of the most important in the State. Good home gardens are not, however, so plentiful as they would be were it not for the ravages of insects and diseases. This Bulletin gives ten different formulas for compounding insecticides and fungicides, and explains the necessity for garden hygiene. The most approved forms of spraying apparatus are illustrated and described, and some trustworthy dealers in fungicidal chemicals are named. Everyone who has even a small garden is interested in the matters this Bulletin treats of. It is sent free to all residents of North Carolina, and will be sent as long as the supply lasts to residents of other States who send 6 cents in postage stamps. Address N. C. Experiment Station, Raleigh, N.C.

— Dr. Arthur MacDonald, specialist in education as related to criminal and abnormal classes, United States Bureau of Education, Washington, D.C., has been appointed official representative of the United States to attend the international congress for experimental psychology at London and also the international congress upon criminology at Brussels. The congress at Brussels will consider crime in its relation to biology and sociology. The congress is extremely cosmopolitan not only as to nationalities, but in the different departments of knowledge which it includes. The criminal must be studied as a member of the race, and this gives rise to the new science of criminal anthropology, or, in short, criminology. Here such questions will be discussed as to whether there is a criminal type distinguished by shape of cranium and face, anatomy of ears and nose, size of orbits and length of jaws. Another important question under this head is whether the criminal is born so or becomes so from his surroundings. In this division of the programme are the names of the celebrated Cesare Lombroso, professor of legal medicine at Turin, and Dr. Brovardel, president of the medical faculty at Paris, and Professor Ferri, senator at Rome. But the criminal must be studied psychologically, that is, as to the nature of his mind and will, and their relation to insanity and moral insanity. Among those who will speak in the congress on this phase of criminality are Dr. Magnan, chief physician of the Saint Ann Insane Asylum of Paris; Dr. Benedikt, the celebrated craniologist at the University of Vienna; and the brilliant French writer and legalist, Judge Tarde. Another and very important side of the criminal is included under the head of Criminal Sociology. This takes up crime in history and politics, the influence of profession and trade on criminality and their bearing in the determination of penalty. But there is a practical as well as a scientific point of view in the study of the criminal. This will be considered in the congress under the title of "Legal and Administrative Applications of Criminal Anthropology." Thus Dr Alimena of Naples will discuss what measures are applicable to incorrigible criminals. Then there are the general and fundamental principles of the school of criminal anthropology, which will be considered by Dimtri Drill of Moscow. Dr. Manouvrier, professor in the School of Anthropology at Paris, is to read a paper on the "Innateness and Heredity of Crime;" Dr. Bruxelles on "The Functional Causes of Crime;" Dr. Sernal on "Suicide and Insanity in Criminals." The distinguished Lacassagne, professor at the University of Lyons, will speak on "The Primordial Sentiments in Criminals" and Dr. Fioretti of Naples on "The Applications of Anthropology to Civil Law." Thus it will be seen that not only specialists in criminology, but those in medicine, insanity, law, psychology, anthropology, and sociology, all will consider the criminal from their respective points of view. The congress for experimental psychology represents the precedent tendency of applying scientific methods to study the relation between mind and body, or mind and brain, subjects which are of as much interest and importance in the case of criminals as of normal men. This is illustrated by the new psycho-physical instrument called the plethysmograph, which indicates the least *increase of blood in the arteries* of the arm. Thus it has been found, that when the sentence of the judge is read before the criminal, there is a decrease in the flow of blood in the arm, but the sight of a glass of wine increases the flow; when, for example, it is required to multiply nine times seventy-three an increase in blood-flow is the result. The flow is little affected in a brutal murderer or born criminal, when a pistol is shown to him, whereas in the normal man the plethysmograph indicates a decided effect. The importance of this new instrument lies in this, that involuntary testimony is given as to the nervous and physical nature of the criminal. It is often unknown to him, and in spite of himself. Dr. MacDonald, after attending these congresses, will visit and study a few of the principal prisons and charitable institutions in England, France, Germany, Belgium, Switzerland, Austria, and Italy. A work of Dr. Macdonald's, entitled "Criminology," will soon be published by Funk & Wagnalls of New York. It is dedicated to Professor Lombroso, who writes the introduction and who himself is the founder of the new science.

— A society which may have opportunities of doing much valuable work has been formed in Wellington, New Zealand, as we learn from *Nature*. It is called the Polynesian Society, "Polynesia" being intended to include Australia, New Zealand, Melanesia, Micronesia, and Malaysia, as well as Polynesia proper. The president is Mr. H. G. Seth-Smith, chief judge of the native land court, while the Queen of Hawaii is patron. There has just appeared the first number of the society's *Journal*, in which there are papers on the races of the Philippines, by Elsdon Best; Maori deities, by W. L. Gudgeon; the Tahitian "Hymn of Creation," by S. P. Smith; Futuna, or Horne Island, and its people, by S. P. Smith; Polynesian causatives, by E T.; and the Polynesian bow, by E. Tregear. There is also a paper giving the genealogy of one of the chieftainesses of Rarotonga, by a native of Rarotonga. The original was written in 1857, and is printed in the *Journal*, with a translation by Mr. Henry Nicholas, and notes by the editors. The editors are of opinion that the paper "apparently supports by direct traditional testimony the theory propounded by Hale, and subsequently advocated by Fornander, of the occupation of the Fiji Group by the Polynesian race, and of their later migration eastward to Samoa and the Society Group."

— The second annual meeting of The Mechanical Engineering Teachers' Association will be held at Rochester, N.Y., beginning Aug. 18, 1892. This place and time of meeting is chosen as coincident with that of the American Association for the Advancement of Science in order to accommodate those who will wish to attend both meetings, and who may not be able to do so if at different times and places. The object of this association perhaps is best stated in Art. II. of its Rules, viz.: "To determine upon, and to secure by co-operation, the best courses of study, and the general adoption of methods of instruction, leading to the highest efficiency of schools of mechanical engineering." The meeting last year was largely occupied with the organization of the association, so that comparatively little time could be devoted to the consideration of courses, methods, or appliances, either by reading of papers or discussion. But it is hoped that the Rochester meeting of this year will be productive of great good in crystallizing the views of the now quite large body of professors and teachers into such tangible and acceptable matters of opinion as to form a working basis for all. The following points are suggested as of importance for study by way of preparation for good work at the meeting, either in the presentation of papers, topical or general discussion, viz.: What subjects should be embraced in the course of mechanical engineering leading to graduation? Should any of them be optional? Should there be a post-graduate course, and if so in what should it consist? What should be the degrees for the above, and what the studies? Should there be included one or two modern foreign languages? What engineering studies should be included? What amount of mechanical laboratory should there be included? What subjects should be included in the mechanical laboratory? How much practice with the object of mechanical and manual training? How much fine mechanical practice such as scraping of surface plates, grinding of standards, etc.? Should the construction of articles of manufacture be attempted at the school laboratory? What testing should be at-

tempted? Should any part of the laboratory practice be classified as shop work, and so named, unless articles are made for sale? Should anything be introduced that should be called "shop work?" Should that portion of the laboratory embracing the manual element be classified as "shop," "school shop," "work shop," etc., or elementary mechanical laboratory? Should the more advanced portion embracing testing of various kinds be classified in such way as advanced mechanical laboratory, testing laboratory, etc.? It is further suggested that particular attention be given to the number of hours devoted to a subject, and the ground covered; the method of instruction, i.e., whether by lecture, recitation or practice, separately or combined. The address of the secretary is, A. J. Wiechardt, South Bethlehem, Pa.

— The North Carolina Experiment Station has distributed a large quantity of broom-corn seed and instructions as to its cultivation to alliancemen and others, with a view to establishing it among the profitable crops in places well adapted for its best development. Close planting on fairly rich land is required for a good crop of brush fitted for making fine brooms. In order to better assist those who desire to learn all they can of this crop, and that all may have the benefit of as much information as possible on the subject of growing broom-corn and making brooms, the Experiment Station will engage to supply as many as wish a copy of "Broom-Corn and Brooms," a small book published by Orange Judd Co. of New York, at the wholesale price, with the postage added. The usual price is 50 cents. Send 30 cents in silver or stamps to the Experiment Station at Raleigh, if you wish a copy of this little book.

— A paper upon the oxidation of nitrogen by means of electric sparks is contributed, by Dr. V. Lepel, to the current number of the *Annalen der Physik und Chemie*. It is well known that small quantities of nitric and nitrous acids and their ammonium salts are produced during the passage of high-tension electrical discharges through moist air. Dr. V. Lepel's experiments, according to *Nature*, have been conducted with the view of obtaining more precise information concerning the nature of the chemical reactions which occur, and the experimental conditions most favorable for increasing the amount of combination. The first action of the spark discharge appears to be the production of nitric oxide, which is immediately converted by the oxygen present into nitrogen peroxide. The latter then reacts with the aqueous vapor present, forming nitric acid and liberating nitric oxide in accordance with the well-known equation $3NO_2 + H_2O = 2HNO_3 + NO$. It has been found, however, that the continued passage of sparks through the same quantity of moist air does not result, as might at first sight be expected, in the conversion of more and more of the atmospheric gases into oxidized products. For the passage of sparks through the gaseous oxides of nitrogen first formed results in their decomposition again into their elementary constituents. If, for instance, spark discharges are passing at the rate of one per second, the whole of the nitrogen peroxide molecules have not time to react with the water molecules to form nitric acid, before the passage of the next spark, and hence some of them suffer decomposition; indeed, it is probable that a number of the nitric oxide molecules first formed have not even time to combine with oxygen to form the peroxide before the passage of the next discharge, which brings about their dissociation. Hence it is, that, in a closed space, a limit is soon reached beyond which there is no further increase in the amount of nitric acid. For this reason the yield of nitric acid has hitherto been very small. Dr. V. Lepel has made experiments, therefore, with a slowly-moving atmosphere, and under different conditions of pressure, and with various types of spark discharge, with the result that he has already increased the amount of combination to 10 per cent of the total amount of air employed. The air is exposed under increased pressure to a series of parallel spark discharges in the same tube. The change of atmosphere is not made continuously, but intermittently, and the gases are expelled from the discharge tube into a large absorption vessel, in which the products are absorbed in a solution of water, or of a caustic alkali. Detailed accounts are a memoir of the efficacy of the various forms of high-charge, and Dr. V. Lepel is now experimenting with the discharge from a Töpler influence machine with sixty-six rotating plates. Of particular interest are his remarks concerning the probable effect of the high-voltage discharges of which we have lately heard so much. He considers it not improbable that by their aid a new mode of producing nitric acid from the atmospheric gases on the large scale may be introduced, rendering us altogether independent of the natural nitrates as a source of nitric acid.

— According to the *Pioneer Mail* of June 8, the residents of Howrah have been finding lately that jackals are animals of anything but an attractive temper. In some cases they have come right up to the bungalows in search of prey. A little girl, aged about five years, was playing in a verandah, when a jackal suddenly rushed on her, and was dragging her away, when she was rescued. She was severely bitten. Three natives, while walking along the Kooroot Road, were attacked by a jackal, which was only driven off after a stubborn fight; and a tale is told of two women, while standing near a tank, being attacked and bitten. So serious has the state of matters become that the public propose to submit a memorial to the district magistrate praying for the adoption of measures for the destruction of these pests.

— C. Creighton, in a letter to *Nature*, June 30, on the immunity of the African negro from yellow fever, says: "This point, interesting to anthropologists, is raised anew by a writer on the history of epidemics (*Nature* June 16), who asks whether the alleged protection is supported by all recent authorities. Recent authorities are not so well placed for judging of this matter as the earlier; for the reason that immunity is not alleged except for the African negro of pure blood or unchanged racial characters, and that these conditions of the problem have been much less frequently satisfied in the yellow fever harbors of the western hemisphere since the African slave trade ceased. However, there was a good opportunity in 1866, during the disastrous yellow fever among the French troops of the Mexican expedition when they lay at Vera Cruz. Among them was a regiment of Nubians, who had been enlisted for the expedition by permission of the Khedive: that regiment had not a single case of yellow fever all through the epidemic. The African negro regiment brought over from the French colonies of Martinique and Guadeloupe had two or three cases, with, I think, one death. The rest of the troops, including Frenchmen, Arabs from Algeria, native Mexicans and Creoles, had no immunity whatever, but, on the other hand, a most disastrous fatality. The medical officers of the French service have recorded the facts principally in the *Archives de Médecine Navale*, their conclusion as to racial immunity being the same that has passed current among the earlier authorities as a truth of high general value (admitting, of course, of exceptions in special circumstances), and a truth that has never, so far as I know, been formally controverted by anyone, although other points concerning yellow fever have been the subject of as obstinate controversy as those touching small-pox itself. The experiences of the French at Gorée, a town with ten times as many negroes as whites, exactly confirmed those of Vera Cruz in the same year (*Arch. de Méd. nav.*, ix., 343). The immunity of the African negro from yellow fever has become a paragraph in some anthropological text-books. It is from the anthropologists, and not from medical authorities, that Darwin cites the fact in his "Descent of Man," adding an original theory of the immunity, which he was unable to establish after much inquiry. His theory, I need hardly say, was not that "negroes in infancy may have passed through some disease too slight to be recognized as yellow fever," — whatever that may mean — "but which seems to confer immunity." The theory, however, is another story, or "another volume," as the writer just cited is pleased to suggest; and as for the historical fact of immunity, no one denies it, unless it be Dr. Pye Smith in his recent Lumleian lectures (*Lancet*, April 23, 1892, p. 901), who gives no reasons. It is unfortunate that the anthropologists (Darwin among them) should have introduced one element of dubiety in placing mulattoes on the same footing, in respect of immunity, as negroes of pure descent, and another in mixing up malarial or climatic fevers with yellow fever."

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

LION BREEDING.

BY DR. V. BALL, C.B., F.R.S., HONORARY SECRETARY ROYAL ZOOLOGICAL SOCIETY OF IRELAND.

THE breeding of lion cubs commenced in the gardens of the Royal Zoological Society of Ireland in the year 1857, and has been continued through an unbroken descent to the end of 1891, or for thirty-five years; from which, if we subtract the five years from 1874 to 1878, inclusive — when there was no breeding lioness in the gardens and no cubs were born — the actual period of breeding lasted only thirty years, during which the average number of births has been 5.3 per annum.

Parents of the Cubs.

MALES	No. of Cubs.	FEMALES.	No. of Cubs.
		Natalie (1857–9)	10
Natal (1857–64)	42	Anonyma (1861–4)	20
		Old Girl (1862–73)	55
Sire unknown (1869)	3	Nellie (1869)	3
Old Charley (1866–74)	47	Biddy (1871)	4
		Victoria (1879–81)	7
		Zenobia (1879–83)	17
Young Charley ('79–84)	27		
		Queen (1884–91)	28
Paddy (1883–91)	31		
		Minnie (1884–6)	6
Romeo (1890–91)	9	Juliet (1890–91)	9
	159		159

Sexes of the Cubs.

Males	85	Females	73
Unknown	1	Forward	86
			159

Percentage of males to females 53.8 to 46.2, or a majority of *7.6 males out*

The Number of Cubs in a Litter.

Total number of litters, 43; number of cubs, 159; average number of cubs in each litter, 3.7.

Of litters	of	6	cubs	there were	2
"	"	5	"	"	8
"	"	4	"	"	17
"	"	3	"	"	9
"	"	2	"	"	5
"	"	1	"	"	2

Thus it will be seen that the average number of cubs in a litter approximates most nearly to 4.

Months in which the Cubs were Born.

January	6		July	5	
February	14		August	13	
March	3		September	27	50
April	22	40	October	23	
May	18		November	13	
June	9		December	6	
	72			87	
			Forward	72	
				159	

It is to be remarked that 90 out of the total of 159 were born in the four paired months, namely, April and May (40) and September and October (50). These amount to 56.6 per cent of the whole number, leaving only 43.4 per cent for the remaining eight months.

Disposal of the Cubs.

Died at, or shortly after, birth	30
" after some months or year	12
Retained for stock	8
Sold (yielding upwards of £4,000)	109
	159

THE PURIFICATION OF WATER BY CHEMICAL TREATMENT.[1]

BY WILLIS G. TUCKER, M.D.

PURE water does not exist in nature. It is an ideal substance to which the purest water that can be prepared by the chemist only approximates. From a chemical standpoint every foreign substance which water may contain is an impurity, but, hygienically considered, water is called impure only when it contains excessive amounts of mineral matter in solution or in suspension; when it contains organic matter of vegetable or animal origin, or the products of the decomposition of such matter in quantities exceeding certain generally accepted but rather arbitrarily assigned limits, or when it is shown to contain living organisms believed to be associated with or productive of diseases which water may communicate. All filth in food or drink is to be abhorred, but, none the less, distinction must be made between that which, containing or accompanying specific disease germs, may give rise to specific diseases, and that which is, while not unobjectionable, yet apparently incapable of materially affecting health. The chemist is as yet unable to distinguise disease-producing from relatively harmless impurities in water. He can recognize those constituents which indicate organic pollution; demonstrate the present existence of putrescent material, or show that such material has previously existed

[1] Read before the Medical Society of the County of Albany at a meeting held February 23, 1892. Reprinted from the Albany Medical Annals, April, 1892.

by the recognition of the products of its decay, but he can by no means assert with certainty that any given water will necessarily give rise to disease or will certainly prove to be wholesome. Waters containing putrescent organic matter of animal origin have been drunk without harmful results. Such cases are on record, and, on the other hand, waters which analysis has shown to be of fair chemical purity have unquestionably given rise to disease. Nevertheless the chemical analysis of drinking waters, despite the limitations and imperfections of our best processes, furnishes most valuable information, in no other way to be obtained, and I shall spend no time in a defense of this method of investigation. There are unmistakable signs of pollution which analysis may reveal, and such warnings should not go unheeded. If it be shown that a well receives the leachings of a privy-vault or cesspool, or that a running stream is contaminated by sewage, as yet unoxidized and possibly infectious, such water should be condemned, and neither chemist nor bacteriologist should be required to demonstrate its disease-producing power. Indeed this would be in most cases entirely impossible, such proof being seldom attainable.

Impurities in water exist in suspension or solution, and may be either inorganic or organic. Suspended matter may frequently be removed, wholly or partially, by mere sedimentation or by some simple process of filtration, but matter which is held in solution must be destroyed or removed in other ways. The boiling of water may produce a deposition of some of its earthy salts, a coagulation and precipitation of some of its organic matter, and a destruction of its micro-organisms including disease germs if present; and while this method of purification is frequently serviceable as a household measure it is not adapted to use upon a large scale. By distillation a still further purification may be effected, but this is a still more costly process and can never come into general use. Within a few days I have examined a sample of distilled water prepared and sold in bottles for table use, in which, while the free ammonia was high, the albuminoid ammonia was very low; chlorine, nitrites, and nitrates absent, and total solids almost nil. Such water is as pure as can well be made on a commercial scale, but it is necessarily too expensive to be commonly used. Aeration has likewise been resorted to for the destruction by oxidation of organic matter, and is said to have been employed more than a century ago by Lind on the west coast of Africa. Considerable improvement has been effected in certain city supplies by pumping air into the mains or reservoirs or by discharging water in jets or fountains into basins so as freely to expose it to the air. Where waters are shown to be deficient in dissolved oxygen, especially in the case of impounded waters in which patches of green algæ appear upon the surface in warm weather, such treatment is often of the greatest value. It is an imitation of a natural process of purification, and the change effected is not to be regarded as purely chemical, being brought about by bacterial organisms, the nitrifying bacteria, which, under favorable conditions and in presence of free oxygen, convert nitrogenous organic matter into harmless inorganic forms.

The purification of polluted water by direct chemical treatment has been effected with more or less success in many ways, all practical methods involving the separation of precipitated matter either by sedimentation or filtration after treatment of the water. In other words, there is no chemical agent which, by simple addition to impure water, will render such water pure and wholesome. By chemical treatment we may precipitate lime and other earthy salts if present in undue quantity, coagulate and remove organic matter and bacteria, or promote the oxidation of such matter; and various processes accomplishing, more or less perfectly, these results, have, during recent years, been employed.

Clark's process, designed particularly for the softening of water owing its hardness to bi-carbonate of lime, consists in the addition of milk of lime, which results in the formation of an insoluble carbonate subsequently separated by sedimentation. Colored and turbid waters are clarified and organic matter and living organisms largely reduced by this treatment, as has been shown by Dr. Percy F. Frankland (*Chemical News*, Vol. LII., p. 40) and others, but if much organic matter is present the precipitation does not readily occur and filtration must be resorted to as in the Porter-Clark process. Other methods for softening water involve the use of caustic soda in addition to slaked lime, as in Howatson's process, and the use of tri-sodic phosphate, now a commercial article, by which means the salts producing permanent hardness are largely removed; and in the household carbonate of soda (washing soda) is employed for the same purpose, though its use is impracticable on a large scale on account of the expense.

Such methods as these, however, are primarily intended for purifying water for laundry use, manufacturing purposes, and making steam. They are more important from a technical than from a sanitary standpoint, and we pass from these to speak of those processes in which the main object is the removal of constituents believed to be harmful to health. Before doing so, however, a few words concerning filtration may not be out of place, the more especially as either sedimentation or filtration is generally necessarily connected with every process intended for the purification of water. Filtration which is a mere straining, as for example, continuous filtration through sand or animal charcoal, may clarify a water without otherwise improving it in any respect, and if, after a time, the filter becomes foul, the water may be polluted rather than improved. I regard with disfavor most of the old-fashioned filtering appliances, which not only gave a false sense of security, but often served as breeding places for the growth of living organisms. A house filter which is not easily cleansed is an abomination, being generally allowed to take care of itself and in time becoming a source of real danger. A few years ago a case of no little interest was reported in the *Chemical News* (Vol. LII., p. 70). Two samples of water were analyzed for a family in which one member was ill with typhoid fever. One of the samples was from the house supply direct, and the other was the same water filtered through a portable charcoal filter of the common type. This latter sample yielded a much larger amount of albuminoid ammonia than the former, decolorized five times as much permanganate of potassium, and was in every respect objectionable. On inquiry it was learned that the filter had been in use for more than a year, and that in the place where the owner had formerly resided he had found the water so bad that he had made use of it to filter that which he used for his bath. A few years ago when typhoid fever prevailed in Providence, R.I., and seemed not to be fairly attributable to the city water-supply, Dr. T. M. Prudden examined several of the filters used in private houses and found the typhoid bacillus in no less than three of them (*New York Medical Journal*, Vol. L., p. 14). Filters giving such results, it need scarcely be said, are a constant menace to health, but those which allow of easy cleaning by reversed currents of water are free from most of the objections attending the use of the older forms. Five years

ago I analyzed some samples of Albany water, filtered through a well-known filter manufactured in this city (the Blessing Duplex Filter), and found that a sample of water obtained by washing the filter after a day's use, yielded of albuminoid ammonia, 0.1850 parts per 100,000, showing that the filter had retained a large amount of organic matter. Water which had passed through the sand of the filter only, yielded 0.0023, and that which had passed through both the sand and charcoal yielded but 0.0014 parts per 100,000. This latter quantity is about one-tenth that ordinarily found in our city water, and this is certainly a very good showing. Two years since I analyzed water which had been drawn from our upper service, both before and after filtration through the same filtering apparatus, and found the free ammonia reduced to a fifth, the albuminoid ammonia to a fourth, and the oxygen absorbed to two-thirds of the amounts originally present, by filtration; while a sample of water from the lower city service had its free ammonia reduced to a fifth, albuminoid to a tenth, and oxygen absorbed to a twelfth, indicating a vast improvement in a water at that time in singularly bad condition. These results I believe to be largely due to the efficient action of the animal charcoal, which in this device acts, not as a strainer or filtering medium proper, but as an oxidizing agent, provision being made for its constant aeration. In many filtering appliances animal charcoal is a fruitful source of trouble and danger, but if the real filtration is accomplished by other material and the coal is subjected to frequent aeration and renewed when necessary, it is a most valuable agent for effecting the oxidation of organic matter. I purpose soon to make some experiments with a view to determining how long animal charcoal retains its activity in such filters, though it is very certain that, with proper treatment, it will continue to operate satisfactorily for a long time.

Of the chemical agents which have been employed in water purification, the most important are metallic iron, solutions of iron salts, generally the chloride, permanganate of potassium, and alum. Spongy iron, obtained by the reduction of hematite-ore at a temperature of a little below that of fusion, thereby rendering the metal porous or spongy in form, was first made use of by Bischof, whose process was patented in England in 1871, though Dr. Medlock had secured a patent in 1857 for a process of purification based upon the use of metallic iron plates, and Spencer in 1867 introduced a material which he called magnetic carbide, in which the active agent was iron. The carbonic acid in the water, acting upon the iron in one or the other of these forms, produces a ferrous carbonate, which, by oxidation, yields hydrated ferric oxide, and this is believed to effect the oxidation of organic matter and serve as a coagulant as well, producing a flocculent precipitate, which is subsequently separated by sedimentation or filtration through sand. Such methods have been employed with more or less success in various European cities, but Anderson's process, which has been successfully used at Antwerp, Ostend, Paris, and Vienna, has generally replaced other methods of purification by iron. In this process the water is forced through revolving purifiers consisting of iron cylinders revolving on hollow trunnions which serve for inlet and outlet pipes. On the inner surface of the cylinders are curved ledges running lengthwise, which scoop up and shower down through the water fine cast-iron borings as it flows through the cylinder, so that every portion of the water is brought into contact with the iron, which is kept constantly bright and clean by attrition. The water issuing from the purifiers is exposed to the air, by allowing it to flow through a trough, to secure the precipitation of the ferric hydrate, and by filtration through sand this precipitate is subsequently removed. It is claimed for this process that the organic matter is altered in form and largely destroyed, the albuminoid ammonia being reduced to from one-half to one-fourth, and micro-organisms largely destroyed or removed. At Antwerp 2,000,000 gallons daily are thus treated, and Professor Edward Frankland has shown that this water is completely sterilized and nearly all its organic matter removed. The cost, previous to the introduction of settling reservoirs before filtration, has been $4 per million gallons. In a paper read before the Franklin Institute in 1890 by Easton Devonshire, C.E., it is estimated that the cost of working expenses, with an output of 5,000,000 gallons per diem or over, should not exceed $2 per million.

Ferric chloride has been employed in Holland for removing clayey matter and organic impurities from the water of the Maas, which supplies Rotterdam. Carbonate of iron is formed and decomposed with separation of ferric hydrate which coagulates and removes the organic matter, but such treatment is attended with many difficulties and is not likely to come into general use. The same may be said of the employment of permanganate of potassium, which oxidizes organic matter and by its decomposition yields manganic hydrate which precipitates much of the suspended matter present in the water. Such processes may be successful, here and there, on a small scale, but they cannot as yet be practically or economically employed in the purification of large supplies.

The only other purifying agent of which we need speak is alum. It is said to have been used for centuries in China and India, but particular attention was first directed to its use by Jennet in 1865. Most waters contain more or less bicarbonate of lime in solution, and the alum acting upon this constituent yields sulphate of lime, carbonic acid gas, and aluminic hydrate, as shown in the following equation:

$$K_2Al_2\,(SO_4)_4 + 3\,H_2\,Ca\,(CO_3)_2 = 3\,Ca\,SO_4 + K_2\,SO_4 + 6\,CO_2 + Al_2\,(HO)_6.$$

As the aluminic hydrate forms and deposits it not only entangles and carries down finely-divided, suspended, mineral matter but coagulates and removes much of the dissolved organic matter as well. By this means peaty and other colored waters are decolorized; turbid waters containing finely divided clay are clarified and bacteria removed. Professor A. R. Leeds, in an experiment performed upon the water used at Mt. Holly, N. J., found that alum, added in the proportion of half a grain to the gallon, produced the following effect: "On standing the peaty matter was entirely precipitated in reddish-yellow flakes and the water above became perfectly colorless and clear. On pipetting off some of this supernatant fluid I found that instead of containing 8,100 colonies of bacteria per cubic centimeter, as it did before precipitation with alum, it contained only 80 colonies. On filtering some of this supernatant water through a double thickness of sterilized filter paper into a sterilized tube I found no bacteria in the filtered water. In other words the water had been rendered, by the addition of an amount of alum so minute as to be inappreciable to taste and almost to chemical tests, as sterile as if it had been subjected to prolonged boiling." (*Journal American Chemical Society*, ix., p. 154.)

Austen and Wilber made a valuable report to the State Geologist of New Jersey in 1885, on the "Purification of Drinking Water by Alum." They found that 1.2 grains per

gallon was sufficient for the complete precipitation and clarification of the New Brunswick city water, if sufficient time was allowed for settling. Such an amount is imperceptible to the taste and can exert no physiological action. If more alum is used less time is required for sedimentation, and *vice versa*. More than two grains to the gallon was seldom required. They showed likewise that waters which will not yield clear filtrates on account of their containing finely divided clayey matters, even when filtered through the finest filter-paper, were immediately coagulated and precipitated by 1.16 grains of alum to the gallon, so that they could be filtered immediately after adding the alum, yielding brilliantly clear filtrates, and, in their opinion, no more than twice this quantity, or about two grains per gallon at most, need ever be employed.

In January, 1889, a sample of peaty water from Athol, Mass., having a decided yellowish-brown color, was submitted to me for examination. Difficulty had been experienced in clarifying this water by filtration, and I made some experiments to determine the action of alum upon it. Our city supply was at that time yellowish in color and slightly turbid, and this was also tested. It was found that, in both cases, the addition of alum in the proportion of 2.3 grains per gallon gave rise at the end of twenty-four hours to a yellowish flocculent deposit, undergoing no further change on standing for four days, the water becoming clear and almost perfectly colorless. The waters were tested again by adding the alum, shaking in a flask, and immediately filtering through paper. The city water became transparent and perfectly colorless, and the peaty water retained but a very faint, almost imperceptible yellowish tint. The peaty water yielded originally 0.0225 parts of albuminoid ammonia per 100,000, but after the addition of alum, agitation and filtration, it yielded but 0.0060 parts, or about one-fourth as much, showing how great an improvement had been effected.

For household use, on a small scale, water can be easily clarified and purified by placing a layer of clean cotton, two or three inches deep, at the bottom of a glass percolator, such as is used by druggists, and pouring the water to be filtered, to which solution of alum has been added, into the percolator and allowing it to drip through into a clean vessel placed to receive it. The alum solution is conveniently made by dissolving half an ounce of alum in a quart of water, and of this solution a scant teaspoonful should be added to each gallon of water to be filtered. Alum is now used in a number of filtering and purifying systems which have of late years been brought prominently before the public by their inventors or the companies controlling them.

If now it be asked, do such processes as these which we have described, admit of practical and economical application to the purification of large volumes of polluted water for the supply of our great cities, I fear that an unqualified affirmative answer can hardly be given. In American cities the consumption of water is much greater than in European towns. The "Encyclopedia Brittanica" states that "the consumption varies greatly in different [English] towns, ranging from about twelve to fifty gallons per head per day," and that "an ample supply for domestic use and general requirements is from 20 to 25 gallons per head daily." With us a hundred gallons is frequently supplied. Albany wants 15,000,000 gallons, with a population of less than 100,000. Philadelphia and St. Louis consume 70 gallons; New York, 80; Boston, 90; Chicago, 115; and Detroit, 150; while Glasgow, Dublin, and Edinburgh consume but 50; London, 40; Birmingham, Leeds, and Liverpool about 30; and Manchester and Sheffield still less. On the continent it is about the same. Paris uses about 50 gallons; Hamburg and Dresden 60, and Leipsic but 23. In American cities the waste of water is enormous and to purify one gallon for drinking and household uses and nine gallons for flushing water-closets, watering streets and extinguishing fires must ever be a wasteful process, to say the least. Many towns in this country are now using water purified by artificial means, with apparent satisfaction; but I do not think that the time has come when it can be said that such purification is practicable in all cases. Certain methods, like the Anderson process, give excellent results under favorable conditions, but competent engineers have not recommended them for American cities. Sedimentation, coagulation, filtration, aeration, all these have passed the experimental stage and are in a sense practical, but that processes involving so much manipulation can be advantageously employed in treating the enormous volumes of water required by large cities, especially where pumping is also necessary, is not as yet demonstrated. As regards filtration alone, it may be said that in our climate the filter-beds, which give satisfactory results in many parts of Europe, cannot generally be employed to advantage, and that this method of filtration has been by no means uniformly successful even in Europe. In a recent report Dr. Theobald Smith has called attention to the fact that in the Berlin epidemic of typhoid in 1889, "the distribution of the disease was identical with that of the filtered river water," the filter beds being worked with great rapidity to make up for a deficiency in the water-supply, and the filtered water containing at times 4,000 bacteria per cubic centimeter. In discussing this case he says: "These facts go far to prove that polluted water, when immediately delivered for consumption even after filtration, is not wholly safe. They likewise make prominent the fact, that, while filtration largely rids a given water of its bacteria, it is a process requiring the utmost care, the most constant attention, not only on the part of the engineer, but also of the chemist and bacteriologist. We are furthermore convinced," he adds, "by these experiments that surface water which shows very little, if any, pollution, and which is stored before use, is safer than filtered water which before filtration is being manifestly contaminated with sewage." As regards methods of rapid filtration under pressure, combining chemical treatment of the water, generally by alum, as well, various systems are in use in this country, controlled by individuals or companies employing a variety of patented devices. Granting that the results in some cases seem to be excellent, I think the time has not yet come when they can be unhesitatingly recommended for the purification, in all cases, of large city supplies. I know of no city with a population of one hundred thousand that is using such a process to-day. That numerous infectious diseases are conveyed by water admits of no dispute. In my opinion it is vastly better to purify our sewage before discharging it into the streams which supply us with water, or keep it out of them if practicable altogether, than to attempt to purify the water which it pollutes. Chemical treatment and filtration may be practicable and efficient in certain cases, but I believe that the statement by the Rivers Pollution Commission of England, more than twenty years ago, in their sixth report, is as true now as it was then: "Nothing short of the abandonment of the inexpressibly nasty habit of mixing human excrement with our drinking water can confer upon us immunity from the propagation of epidemics through the medium of potable water." The cities of this country may eventually be driven to methods of arti-

ficial purification of their water supplies, but it cannot be said that the conditions necessitating such action generally exist as yet. In most cases the safer and more economical course will be found to be either the securing of an unpolluted water, if such be available, or the protection from pollution of existing sources of supply.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

American Weeds.

PROFESSOR BYRON D. HALSTED of the New Jersey Experiment Station has recently presented to the agricultural public a list of "American Weeds," — mostly phanerogams, — which contains no less than 751 varieties and species, exclusive of noxious fungi. Well may the long-suffering farmer turn up the whites of his eyes at this formidable list. A closer examination, however, shows us among the "weeds" all our cultivated clovers, medics, vetches, and many of our best agricultural grasses. The criterion used by the New Jersey botanist in deciding what to admit and what to exclude from his catalogue is not apparent, and no word of explanation is vouchsafed.

In the vegetable kingdom, if not in the United States Republic, it is true that "it is self-evident that all plants are born free and equal." The distinguishing of plants as weeds and not weeds is purely human and artificial. The popular idea of a weed seems to be a repulsive, or hurtful, wild plant. But few persons give exactly the same definition. I have been at some trouble to secure the definitions of a number of intelligent persons, and give below a few samples: —

"A plant where you don't want it." — *Director Experiment Station.*

"A noxious or useless plant." — *Curator of Museum.*

"A plant out of place." — *Chemist.*

"A troublesome plant." — *Chemist.*

"An obnoxious plant of many species not fit for food or medicinal purposes." — *Clerk.*

"A plant not edible, so far as known, nor medicinal, or otherwise serviceable to man, and which always thrives where not wanted." — *Inspector of Fertilizers.*

"A plant for which we have no use so far as we know." — *Meteorologist.*

"(1) Underbrush or bushes; (2) a useless or troublesome plant." — *Webster.*

My own definition: Any plant which from its situation or inherent properties is hurtful to human interests; a vegetable malefactor.

By the usage of the English language the name "weed" is connotative and implies in a plant a bad and hurtful quality. Used metaphorically or analogically it is always a term of opprobrium.

If we were dealing with individual plants as courts of justice deal with persons, each particular plant might be properly described as a weed or not weed according to the circumstances of each case. But here we are dealing not with individuals but with species and varieties, and can take note only of the general character of the groups. If we have planted a bed of pansies, and there springs up among the pansies a red clover plant, this particular plant is hurtful to us, and therefore is treated as a weed, but we are not therefore justified in writing the species *Trifolium pratense* in a list of weeds. The general character, — the qualities for which the clover genus generally and this species especially are noted, are good and beneficial to mankind. It was only by chance or the carelessness of some one that this clover plant got into our flower-bed. "The plant out of place" definition of a weed can refer only to a particular plant. It cannot be applied to a species, for a plant of any species is liable to be occasionally misplaced.

We must maintain then that the inclusion in a list of weeds of such plants as the clovers, medics, vetches, and agricultural grasses is unjustifiable and wrong.

A large number of Professor Halsted's "weeds" are mere "wildlings of nature" for which we have as yet found no important use. But justice requires that in the case of plants as well as persons every one shall be held innocent until proven guilty of wrong.

Both from an æsthetic and from a practical standpoint it is true that most of these so-called weed plants are more useful than hurtful. They clothe and beautify waste places. Many of these wild plants furnish food and nectar for honey bees, and all aid more or less in conserving the fertility of the soil, prevent washing etc. It is as unjust to stigmatize such plants as "weeds" as it would be to call all savage tribes criminals.

Professor Halsted omits wholly and without comment noxious fungi from his list of weeds. Yet these are our very worst and most dangerous weeds. In number they far outrun all the phanerogamic species.

To justify its inclusion in a list of "American weeds" a plant must not only possess a positively noxious character, but must also be sufficiently obnoxious or wide spread to give it a national reputation.

If we exclude from Professor Halsted's list all obscure and non-noxious species we shall have left about 150 *species* of weed-plants worthy to be called "American Weeds."

GERALD MCCARTHY.

N. C. Experiment Station, July 5.

Some Remarks on Professor Cyrus Thomas's Brief Study of the Palenque Tablet.

IN *Science*, No. 488, Professor Cyrus Thomas stated that "the particular manner of reckoning the days of the month" — or more precisely, the exact designation of a date by the sign of the day and the position it holds in the number of twenty days (*uinal*) that people are in the habit of calling a Maya month – as it is found not only "in some of the series of the Dresden Codex," but throughout the whole of it, is also found on the Palenque tablet. This statement undoubtedly is a correct one. But Professor Thomas, following Professor Förstemann, asserts that the "peculiarity of this method is that the day of the month is counted not from the first of the given month, but from the last of the preceding month; thus the fifteenth day of *Pop*, beginning the count with the first, will, according to this method, be numbered 16." If it were really so, this method of reckoning the days of the month would be a very curious one, and hardly to be understood. Professor Förstemann based this assertion on the supposition that the calendar system of the Dresden Codex is the same as that which prevailed in Yucatan at the time of Bishop Landa's writing. In vol. xxiii. of the *Zeitschrift für Ethnologie*, published by the Berlin Anthropological Society, in a paper entitled "Zur mexikanischen Chronologie, mit besonderer Berücksichtigung des zaposekischen Kalenders," I have shown that the priests who wrote down the Dresden Codex did not begin their years with the days *kan, muluc, ix, cauac*, as in Landa's time, but with the days *been, e'tznab, akbal, lamat*, exactly corresponding to the *acatl, tecpatl, call, tochtl* (cane, flint, house, rabbit), the signs used by the Mexicans to designate their respective years. Beginning the years in this manner, the day 4 *ahau* 8 *cumku* is really the eighth day of the month *cumku* in the *been*, or "cane," years. The day 9 *kan* 12 *kayab* is really the twelfth day of the month *kayab* in the same *been*, or "cane," years; and thus with all the other dates throughout the whole Dresden Codex.

The evidence derived from the fact that the same method of numbering the days of the month, that is to say, the same method of beginning the years, is also found in the Palenque tablet, leads — I agree with Professor Thomas — to the inference "that there were intimate relations between the people of this city and those where the Dresden Codex was written, and that there is no very great difference in the ages of the two documents." On the other

side, it is proved by my statements that in this peculiarity both the Dresden Codex and the Palenque tablet differ from the Codex Troano-Cortez. For in the latter document the beginning of the years is in the days *kan*, *muluc*, *ix*, *cauac*. This is proved by Codex Troano 23-20, when compared with the Dresden Codex 25-28. From this, and the general character of the Codex Troano-Cortez, we may safely infer that this manuscript is of a later date than the Dresden Codex, and, perhaps, of a somewhat different locality.

Alluding to 9 C 9 D of the Palenque tablet, Professor Thomas remarks that on plate 48 and twice on plate 50 of the Dresden Codex no number-symbol is attached where the day is the twentieth of the month. This is obviously an erroneous statement; for in all the three cases named, and also in the Palenque tablet, there is a particular element attached to the hieroglyph of the month; and this particular element reveals itself as a graphic representation of the two eyes of the man (*uinic*), the substitute of the head of the slain, which I have shown is the usual representation of the man (*uinic*) or the number twenty (*uinal*) (see *Zeitschrift für Ethnologie*, XIX., pp. 237–240.

With reference to Professor Thomas's last remarks, I will add that the symbol of the hand, as it is seen in the hieroglypth *mänik*, is to be understood as a sign-language character for "to eat," and therefore has the phonetic value *chi* (compare the hieroglyph *chikin*, west). The figure of the outstretched hand occurs as a substitute for the hatchet, the probable expression of the sound *ch'ac*, "to cut." The proper phonetic and figurative value of the outstretched hand seems to be *pax*, "to beat."

DR. ED. SELER.

Steglitz, Germany, June, 1892.

A Grape Vine Produces Two Sets of Leaves During the Same Season.

THE scarcity of information upon the production of leaves at abnormal times furnishes an excuse for the following communication.

In the yard adjoining me there is a large grape-vine of several years' growth. A month ago this was a vigorous plant; the leaves were numerous and healthy, and the branches were loaded with grapes. About that time numerous caterpillars attacked the vine, and in less than a week there was not a leaf left upon it. Numerous petioles, bearing fragments of the principal veins, were all that remained of the foliage. The grapes began to shrivel, and the smaller twigs to show signs of premature decay.

But the end was not yet. About a week after the leaves were destroyed, buds located at the nodes — buds which normally would have remained dormant until next year — began to develop a second foliage. Although not yet full-grown, these leaves have given a new lease of life to the vine. The few shriveled bunches of grapes that have survived the great draught upon their moisture are rapidly regaining their plumpness. The plant is itself again.

One fact is worth noting; although almost four weeks have elapsed since the leaves were destroyed, the petioles remain attached to the stems. These petioles are as green as ever, and in most cases they retain short bits of the principal veins of the leaves. Near the petioles these veins are green, but their free extremities are shriveled and brown.

C. H. TURNER.

University of Cincinnati, July 10.

BOOK-REVIEWS.

The Stone, Bronze, and Iron Ages. A Popular Treatise on Early Archæology. By JOHN HUNTER-DUVAR. London, Swan Sonnenschein & Co. New York, Macmillan & Co. 285 p. $1.25.

As the author claims for this book no other character than that of a popular treatise, it will be sufficient to inquire whether it is a fair representation of the most approved views of the science, as expressed by those who have made it a speciality. This it usually is, although the author, who never quotes his authorities, has inserted opinions here and there which are certainly not those generally accepted. For instance, he understates the artistic relics of the Palæolithic period; he assumes that the weapons of the river drift were more ponderous than those of later date; he asserts that no idols have been recovered from the stations of that epoch; and that no human remains have been unearthed from the European kitchen-middens. Our countrymen will also be surprised to learn that Mound City is another name for St. Louis (p. 142).

In spite of such slight blemishes, the book can be recommended as a convenient and usually accurate manual of this attractive science. It begins at the beginning, tracing the story of man from early post-tertiary times through the drift and cave periods in Europe, and the neolithic, bronze, and iron ages. There are special chapters on the lake-dwellers, fossil man, myths, pottery, sepulture, and art, and one on the mound-builders of the Ohio Valley.

Journal and Proceedings of the Royal Society of New South Wales. Vol. XXV. 1891. 348 p.

THE creditable publications of this active society have already reached their twenty-fifth volume, and it comes replete with entertaining material. Several reports from the Sydney Observatory on celestial photography will have interest for the astronomer; articles on Kaolinite and the microscopic structure of Australian rocks will attract the geologist; the causes of death among sheep and rabbits in Australia will be welcome to the agriculturist; the folk-lorist will turn with pleasure to Mr. Pratt's translations of songs and myths from Samoa; while the mechanicians and cranks will be glad to read about a ship which can be propelled by the action of the waves alone, and a flying machine which is to navigate the sky by the motive power of compressed air. This is certainly a varied repast, at which each may find a dish to his liking.

AMONG THE PUBLISHERS.

A WORK on the "Migration of Birds," by Charles Dixon, will shortly be published by Messrs. Chapman & Hall.

— Messrs. Longmans, Green, & Co. have issued a third edition, revised and enlarged, of Professor E. A. Schäfer's "Essentials of Histology." The intention of the author is to supply students with directions for the microscopical examination of the tissues.

— A "Dictionnaire de Chimie industrielle" is being issued in parts, under the direction of A. M. Villon, by the "Librairie Tignol." It gives an account of the applications of chemistry to metallurgy, agriculture, pharmacy, pyrotechnics, and the various arts and handicrafts.

— Henry Stevens & Son, 39 Great Russell Street, London, promise for next month Henry Harisse's "Discovery of North America: a critical, documentary, and historic investigation, with an essay on the early cartography of the New World," etc. This important work by the foremost investigator in the field will make a quarto volume of 800 pages, with 23 plates and many illustrations in the text, and will be issued to subscribers in three styles, ranging in price from £5 to £12 16s. Only 360 copies are to be printed.

— The American Society for the Extension of University Teaching, Philadelphia, has just issued five monographs on various phases of the university extension movement, being reprints from the Proceedings of the Society. These are: "The Place of University Extension in American Education," by William T. Harris, U. S. Commissioner of Education; "The Organization and Function of Local Centres," by Michael E. Sadler, secretary of the Oxford University Extension Delegacy; "The Church and University Extension," by Rev. John S. Macintosh; "The Ideal Syllabus," by Henry W. Rolfe; and "The University Extension Class," by Edward T. Devine.

— With the number for July, the "Annals" of the American Academy of Political and Social Science begins its third volume. The first article in the current number is entitled "Cabinet Government in the United States." It is by Professor Freeman Snow of Harvard, and is an answer to the many pleas for the adoption

in the United States of cabinet government as known abroad. The next article is by Mrs. S. L. Oberholtzer, and relates how much good "School Savings Banks" have done and are doing. Professor J. B. Clark of Smith College has a paper on "Patten's Dynamic Economics," in which he explains the latest system of political economy, taking up Professor S. N. Patten's recent book as a basis for his remarks. Professor Léon Walras of Lausanne contributes an article on the "Geometrical Theory of the Distribution of Prices," in which he presents a geometric picture of the causation of the prices of all commodities. Besides these there are articles by Mr. B. F. Hughes on "Basis of Interest," by Leo S. Rowe on the "Conference of the Central Bureau for the Promotion of the Welfare of the Laboring Classes," by Takekuma Okacla on "Taxation in Japan," and the usual book-reviews and personal notes.

— W. H. Lowderwilk & Co., Washington, announce that they have assumed the publication of "Hickcox's Monthly Catalogue of Government Publications," which they will complete up to date and issue regularly and promptly in the future. Mr. Hickcox will edit the catalogue as heretofore, but all rights in the work have been purchased by the publishers. Up to this time the work has been prosecuted under many difficulties, and the pecuniary returns have been very inadequate, by reason of which facts it was not kept up with the regularity which its importance demanded. It is expected to issue early in July the first six numbers of 1892, under one cover, succeeding numbers to follow early in each month thereafter. As rapidly as the matter can be prepared the back volumes will be completed and sent to subscribers. It is not expected that the undertaking will prove a remunerative one, but it is hoped that there will be a return sufficient to repay the actual outlay of money. The work is of the utmost value to every person who has occasion to handle or consult the current publications of the government, and these publications are now so varied and comprehensive that persons interested in any branch of science or business must appreciate it.

— Under the title of "The Cambridge Natural History," Macmillan & Co. have in active preparation an important series of volumes on the Natural History of Vertebrate and Invertebrate Animals, edited, and for the most part written, by Cambridge men. While intended in the first instance for those who have not had any special scientific training, the volumes will, as far as possible, present the most modern results of scientific research. Thus the anatomical structure of each group, its development, palæontology, and geographical distribution, will be considered in conjunction with its external character. Care will, however, be taken to avoid technical language as far as possible, and to exclude abstruse details which would lead to confusion rather than to instruction. The series will be under the general editorship of Mr. J. W. Clark, the university registrar, and Mr. S F. Harmer, superintendent of the Museum of Zoölogy. The following writers

Publications Received at Editor's Office.

BUSH, GEORGE G. History of Higher Education in Massachusetts. Washington, Bureau of Education. 8°, paper. 455 p.

HUNTER-DUVAR, JOHN. The Stone, Bronze and Iron Ages. New York, Macmillan & Co. 12°. 285 p. $1.25.

MAYO, A. D. Southern Women in the Recent Educational Movement in the South. Washington, Bureau of Education. 8°, paper. 330 p.

MERZ, CHARLES H. Influenza. Sandusky, O. Beecher & Co., Printers. 12°, paper. 96 p.

U. S. DEPARTMENT OF AGRICULTURE. Foods and Food Adulterants. Part 7: Tea, Coffee and Cocoa Preparations. Washington, Government. 8°, paper.

——Experiments with Sugar Beets in 1891. Washington, Government. 8°, paper.

——Record of Experiments with Sorghum in 1891. Washington, Government. 8°, paper.

WEISMANN, AUGUST. Essays upon Heredity. Trans. by E. B. Poulton and A. E. Shipley. Vol. II. Oxford, Clarendon Press. 12°. 236 p.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Taxidermist going out of business has quantity of finely-mounted specimens of North American birds, mammals and reptiles and skins of birds for sale, including a full local collection of bird skins, showing some great variations of species; also quantity of skulls with horns of deer and mountain sheep, and mounted heads of same. Will give good exchange for Hawk Eye camera with outfit. Apply quickly to J. R. Thurston, 265 Yonge St., Toronto, Canada.

For exchange.—A fine thirteen-keyed flute in leather covered case, for a photograph camera suitable for making lantern slides. Flute cost $27, and is nearly new. U. O. COX, Mankato, Minn.

To exchange; Experiment Station bulletins and reports for bulletins and reports not in my file. I will send list of what I have for exchange. P. H. ROLFS, Lake City, Florida.

Finished specimens of all colors of Vermont marble for fine fossils or crystals. Will be given only for valuable specimens because of the cost of polishing. GEO. W. PERRY, State Geologist, Rutland, Vt.

For exchange.—Three copies of "American State Papers Bearing on Sunday Legislation," 1891, $2.50, new and unused, for "The Sabbath," by Harmon Kingsbury, 1840; "The Sabbath," by A. A Phelps, 1842; "History of the Institution of the Sabbath Day, Its Uses and Abuses," by W. L. Fisher, 1859; "Humorous Phases of the Law," by Irving Browne; or other works amounting to value of books exchanged, on the question of governmental legislation in reference to religion, personal liberty, etc. If preferred, I will sell "American State Papers," and buy other books on the subject. WILLIAM ADDISON BLAKELY, Chicago, Ill.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862-1885 (62-71 bound); Smithsonian Reports, 1854-1883; U. S. Coast Survey, 1854-1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

Wanted, in exchange for the following works, any standard works on Surgery and on Diseases of Children: Wilson's "American Ornithology," 3 vols.; Coues' "Birds of the Northwest" and "Birds of the Colorado Valley," 2 vols.; Minot's "Land and Game Birds of New England;" Samuels' "Our Northern and Eastern Birds;" all the Reports on the Birds of the Pacific R. R. Survey, bound in 2 vols., morocco; and a complete set of the Reports of the Arkansas Geological Survey. Please give editions and dates in corresponding. R. ELLSWORTH CALL, High School, Des Moines, Iowa.

To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

Wants

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

WANTED.—A collection of postage stamps; one made previous to 1870 preferred. Also old and curious stamps on original letters, and old entire U. S. stamped envelopes. Will pay cash or give in exchange first-class fossils, including fine crinoids. WM. F. E. GURLEY, Danville, Ill.

WANTED.—To purchase laboratory outfit; balances, evaporating dishes, burettes, etc., wanted immediately for cash. C. E. SPEIRS, 23 Murray street, New York. P. O. Box 1741.

WANTED.—The services of a wide-awake young man, as correspondent, in a large manufacturing optical business; one preferred who has a thorough knowledge of microscopy and some knowledge of photography. Address by letter, stating age and references. Optical, care of Science, 874 Broadway, New York.

WANTED.—We want any and all of the following, providing we can trade other books and magazines or buy them cheap for cash: Academy, London, vol. 1 to 28, 35, Jan. and Feb., '89; Age of Steel, vol. 1 to 66; American Antiquarian, vol. 1, 2; American Architect, vol. 1 to 6, 9; American Art Review, vol. 3; American Field, vol. 1 to 21; American Geologist, vol. 1 to 6; American Machinist, vol. 1 to 4; Art Amateur, vol. 1 to 7, Oct., '4; Art Interchange, vol. 1 to 9; Art Union, vol. 1 to 4, Jan., '44, July, '45; Bibliotheca Sacra, vol. 1 to 46; Godey's Lady's Book, vol. 1 to 20; New Englander, vol. 11; Zoologist, Series 1 and 1, Series 3 vol. 1 to 14; Allen Armendale (a novel). Raymer's "Old Book" Store, 243 4th Ave. S., Minneapolis, Minn.

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are engaged upon the groups which precede their names: Mammals, Mr. J. J. Lister; Birds, Mr. A. H. Evans; Reptiles and Amphibia, Dr. Gadow, F.R.S.; Fish, Mr. W. Bateson; Mollusca, Mr. A. H. Cooke; Polyzoa, Mr. S. F. Harmer; Brachiopoda, Mr. A. E. Shipley; Insects, Mr. David Sharp, F.R.S.; Myriapoda, Mr. F. G. Sinclair; Arachnoida, Mr. C. Warburton; Crustacea, Professor W. F. R. Weldon; Cœlenterata, Mr. S J. Hickson; and Sponges, Dr. W. J. Sollas. It is hoped that some of the volumes which are already far advanced may appear in the course of next year. The series will be fully illustrated.

— The Biblia Publishing Company of Meriden, Conn., has just issued its initial monthly number of "Ancient Egypt in the Light of Modern Discoveries," edited by Chas. H. S. Davis, Ph.D., and Rev. Camden M. Cobern, Ph.D., with an introduction by Rev. W. C. Winslow, LL.D. Over one hundred illustrations will appear in the twenty-four monthly parts; in the June issue are maps of Egypt as a whole, of Upper Egypt, of Lower Egypt, of the Basin of the Nile, of the Canal of Joseph, and of Egypt during the pluvial period; this opening chapter treats of "Egypt and Its Original Inhabitants," and it is largely ethnographical in its cuts and letterpress.

— Mr. F. Turner contributes to the April number of the *Agricultural Gazette of New South Wales* a paper on the carob bean tree as one of the commercial plants suitable for cultivation in New South Wales. The Agricultural Department distributed a quantity of seed last year, and some healthy young plants raised from this seed are now growing in several parts of the colony. Mr. Turner expects that when the tree becomes better known to cultivators it will be extensively grown to provide food for stock, more especially during adverse seasons. The carob can not only be trained into a very ornamental shade tree, but may be planted as a wind-break to more tender vegetation. He advises all who cultivate it to keep bees, if only a single hive. It is astonishing, he says, how many flowers these industrious insects will visit in the course of a day, and be the agency whereby they are fertilized.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Botanical Laboratory, A.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cercopidæ.
Canada, Royal Society of.
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Fishes, The Distribution of.
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Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
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Influenza, Latest Details Concerning the Germs of.
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Inventions in Foreign Countries, How to Protect.
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Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

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SCIENCE

NEW YORK, JULY 22, 1892.

A VISIT TO A "PICT'S HOUSE."

BY DAVID MAC RITCHIE.

As I have to-day visited an admirable specimen of the underground structures so frequently found in Scotland, where they are popularly known as "Picts' Houses," some description of it will, I think, prove interesting to the readers of *Science*, although the place itself has long been known to antiquaries. There are very many examples of these structures in the British Isles, notably in Scotland and Ireland, but unfortunately the information regarding them (almost invariably most exact and detailed) is for the most part buried in the various volumes of "Transactions" of antiquarian societies, and is thereby practically useless. If the descriptions already published regarding these buildings, together with reproductions of the diagrams illustrating them, could be focussed into one volume, the result would be of the highest interest to those who have paid attention to the subject, and would be a positive revelation to those who have not yet done so.[1] And one great advantage to be derived from a comparison of the various delineations would be that the student would realize that, although such structures are referred to under many names (such as underground caves, souterrains, weems, cloghauns, Picts' Houses, and — popularly — fairy halls), they all belong to one great class.

The specimen visited by me to-day is situated at Pitcur, in Forfarshire, about two miles to the south-east of the small town of Coupar-Angus, and is locally known as "the Picts' house." It is entirely beneath the surface of the ground, and the portion of it which is still covered over stretches for about twenty feet beneath a ploughed field. That is to say, its roof is covered by a foot or two of soil, through which the plough passes without ever striking the flat, stone roof below. In other cases, indeed, the ploughshare has often been the first discoverer of these subterranean galleries.

The ground-plan of the Pict's House at Pitcur may be roughly described as of a horseshoe shape, with a shorter gallery parallel to the exterior curve of one side. The horseshoe itself is about 130 feet in length from end to end, with an average depth of 6 or 7 feet, and an average breadth of about 6 feet. The shorter gallery is about 55 feet long, and its dimensions otherwise resemble those of the horseshoe, except that it broadens out into a bulbshape at the inner end — a common feature in such structures. The line of length, in each case, is taken along the middle of the gallery, there being, of course, a great difference between the length of the inner and outer curves.

Be it understood that both of these galleries are, as it were, great symmetrical ditches or drains, quite underground, and entered by several burrow-like doorways. Their sides have been carefully-built walls of large, unhewn, unmortared stones, and these are still to a great extent unimpaired. The roof was formed by bringing the upper tiers of the wall slightly together, and then placing huge slabs of stone across from side to side. Two of the largest of these roof-slabs measure as follows: One (the largest of all) is about 74 inches in length, by 58 inches in breadth, and from 11 to 13 inches in thickness, its shape being an irregular oblong. The other is about 60 inches long, by 48 inches broad, and 12 inches thick. These are certainly very large specimens, but one is always struck by the great size of the flag-stones used in roofing these underground retreats. I have described as unhewn all the stones employed in this building, but (as in similar cases) one is led to conjecture that some rough process of shaping must have been adopted, although the outlines are perfectly rude, and no trace whatever is visible of any tool. The selection of these great stones, whether from a quarry or a hillside, their carriage to the scene of action (often from a very great distance), and the method used in placing them in position, are all problems which have greatly puzzled antiquaries.

In the Pitcur "house" most of the roof-slabs have disappeared, having obviously shared the fate of so many monuments of antiquity, at the hands of proprietors and farmers in need of building materials and quite devoid of all interest in archæology. But (perhaps because it goes underneath arable land) the northern portion of the great horseshoe gallery still retains its roof; and this part of the building is, therefore, in all probability, in its original condition. It appears to have been of itself a "house," apart from the main gallery of which it forms a portion, for it has a carefully-built doorway leading into the main gallery; and, moreover, an extra ascent to the upper earth leads from the side of the wall just at the outside of this doorway. On going through the doorway of this inner portion, one finds, on the right hand, a small recess in the wall, about 33 inches high, 23 inches broad at the floor, and going into the thickness of the wall about 21 inches. Although this cavity is 23 inches broad at the base, the two slabs which form the supports of its little doorway are made to slant towards the top, where the breadth narrows to 14 inches. Within this recess it is possible for a man of 5 feet 10, and of proportionate breadth, to sit in a squatting posture; but it is a very "tight fit." I am particular in giving the dimensions of this recess, because the late Captain Thomas, a naval officer who devoted much time and study to these subterranean structures, and who found this little recess on the right hand of many of their doorways, regarded them as probably identical with the "guard-cells" of the Pictish "brochs." Captain Thomas quite realized that if these were really "guard-cells" they were useless for any but men of distinctly small stature — an attribute of the Picts, according to tradition.

It is difficult to convey a true idea of such buildings by written description alone, but perhaps these notes will give the readers of *Science* some impression of an example of a very interesting class of structures.

Easter Logie, Perthshire, Scotland, July 1.

[1] I may mention that, as a small beginning in this direction, I am about to issue a pamphlet (published by David Douglas, Edinburgh) containing several written descriptions and sketches of such structures; extracted from the "Proceedings of the Society of Antiquaries of Scotland."

KEY TO THE MAYA HIEROGLYPHS.

BY CYRUS THOMAS, PH.D.

I GIVE here in as limited space as possible a list of the Maya letter 'glyphs so far as I have determined them, together with the corresponding phonetic equivalents; and some examples of my attempts at deciphering the written characters of the Codices.

It is necessary to explain that the letter-equivalent given to each is to be understood as only the chief phonetic element of the character represented, for, in most cases, more than this chief or prominent element is included in the one symbol. The consonant sounds are those chiefly represented, but the character, as a rule, combines therewith a vowel and sometimes even a subordinate consonant sound. Hence it happens that the same consonant sound is represented by several different characters depending upon the subordinate phonetic elements combined with it. A change, however, in the character does not necessarily follow from a change in the order of the phonetic elements it represents; thus, what denotes *ci* as a prefix may stand for *ic* or *c* at the end.

The examples given of the added vowel and subordinate consonant elements, are intended only as asserting that such combinations have been discovered; there may be, and probably are, others. As it would require too much space and too many illustrations to give full explanations of the steps by which I have reached the conclusions given, I must take for granted that those interested in the subject will be able to test these from what is presented.

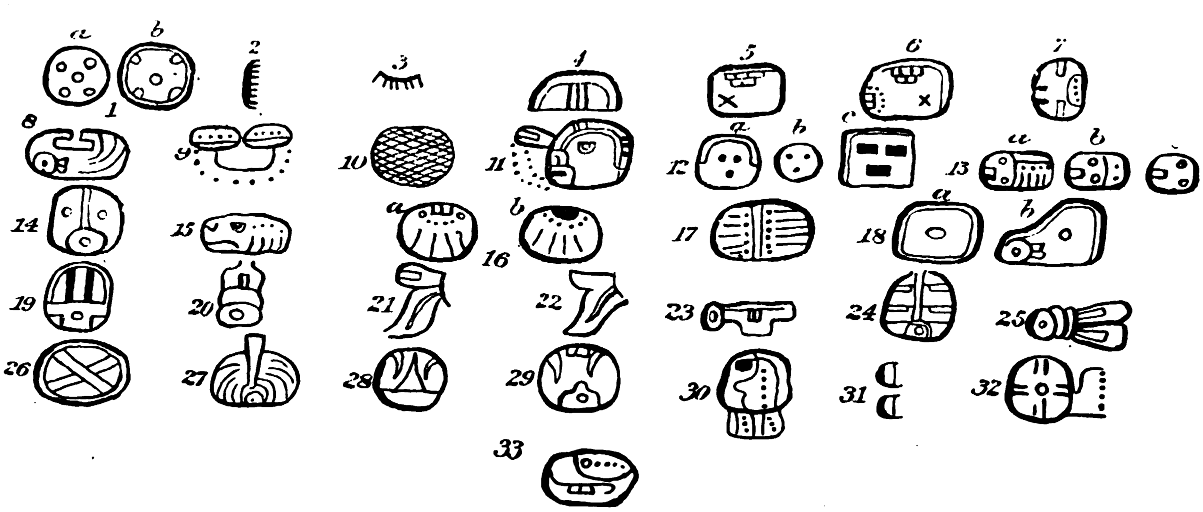

Fig. 1.

Letter Symbols (Fig. 1).

1 (a, b). *B'*.—I find no marks or rule by which to determine from the symbol alone the combined phonetic elements. This is Landa's character for *b* with a dot added.

2. *Ca*.— As a prefix, sometimes *ka* in the Cortesian Codex; *c* hard or *k* as final. Landa's character.

3. *C'*.—This is generally found in place of an eye where it denotes *cim, cin,* or *ci.*

4. *C'*.— *Ci* as a prefix, *ic, ich,* or *c* as a suffix or final.

5. *C'* or *K*. — The characters 5 and 6 are quite variable
6. *CH'*

and often difficult to determine because the complete form intended is not always given. In some instances the little dot-surrounded character at the left of 6 is solid, then a slightly different rendering appears to be demanded. Landa's *k* appears to be a combination of Nos. 3 and 5. The latter sometimes contains the dotted portion seen in 6. No. 6 is frequently found where it must be interpreted *che*, "wood," yet occurs without the dot-surrounded portion where it has the same signification. Other variants are found in the Dresden Codex.

7. *K'*.— Found as *ke* and *ek*, also as *Ce*.

8. *Ch'*.— Sometimes *chi*, as in the symbol for *Chikin*, "west;" *'Ch'* as final. Landa's first *x* appears to be an attempt to give this character which is the partially closed hand.

9. *KU'*.— Landa's symbol. This does not appear to be subject to any variations that affect its phonetic value.

10. *X'*.— Cross-hatching usually indicates *x* (sh) as the leading phonetic element; however, it is sometimes rendered by *ch'*, as is evident from its appearance in the symbol for the day Chicchan if we consider it phonetic. However, the day symbols cannot always be relied upon in this respect, as will be seen by what follows.

11. *X'*.— Landa's second *x* is substantially the same as this character. But he has taken two characters for one, as in this the *x* is represented by the dotted lines alone; the little loop at the forehead, or rather the little parallelogram, in it is *a*; the face character *n*. The whole character appears to be properly rendered by *xan*, "slowly, leisurely, gently." The chief variation in the combination is found in the loop at the forehead, which may be a vowel or consonant. This form of *x* is seldom found except in combination with *n*.

12 (a, b, c). *E* and *Ee*.— The variations are shown in 12b and 12c.

13 (a, b, c). *L'*.— This is Landa's first *l*. The variations are shown in 13b and 13c. Found in combination with different vowels, as *le, ol,* etc.

14. *L'*.— If Landa's second *l* be turned round it will be found to be a rude imitation of this character, which is the symbol for the day *Ahau*. *Li*, in the symbol for *Likin*, East; follows *ku*, etc.

15. *M'*,-*Me*.— Symbol for the day *Men*.

16 (a, b). *M'*.— Varies in having the little loops at the top, sometimes solid, as in 16b. The dot-surrounded portion of 16b is used alone in one series of the Cortesian Codex for this letter followed by *e*. The combinations have not been traced.

17. *M'*.— This appears to be another form of *m*, or *m*

doubled, or combined with *n*. Not satisfactorily tested as yet, though *m* is certainly the chief phonetic element.

18 (a, b). *M'* (?).— Although not thoroughly traced, I am satisfied that this character, which is the symbol of the day *Muluc*, has *m* as its chief phonetic element, generally with *o* or *u*. The part representing the *c* is omitted from the day symbol, but is found in the little ring and loops in 18b. The form of the contour of a character is generally of no significance as it may be round, square, or deeply notched without any change in its meaning.

FIG. 2.

19. *P* or *Pp* (?).— Although I have not tested this satisfactorily, I am certain from my examinations that its phonetic equivalent is *p* usually *pp*. There are some variations found chiefly in the lower portion. The *p* and *b* appear to be interchangeable in the Codices even in the same word; for example in the Dresden Codex 48c, we find the *b* character in the symbol for the month *Pop*, while on 50b it is replaced in the same month symbol by our No. 19.

20, 21, 22. *T'*.—These characters (20, 21 and 22) appear to have *t* as their chief phonetic element, varied according to the markings in the upper portion. No. 20 is also varied by the marks in the lower or middle circle.

23. *Th'*.— Is followed by *e* and *i*.

24. *Tz'*.— I am also inclined to believe that the two streamers or lines which extend upward in characters, as in the symbol for the month *Tzec*, indicate the presence of this sound.

25. *Z'*, *Za*.—Varied according to the markings in the wings and circle.

26. *Ɔ* (dz).— Sometimes *z*.

27. *Y'*.— The index to the variations in the signification if there be any, which is doubtful, will probably be found in the length and form of the stem.

28. *Bal* or *bil* (?).—This is the symbol for the day Acbal.

29. *Ch* (?).— Usually followed by *o* or *u* when not terminal. Is the symbol for the day *Chuen*.

30. *Cab*.— The signification of the appendage so often found attached below this symbol has not been ascertained.

31. *H'*.— Sign of aspiration, the open ends always turned toward the character with which it is connected.

32. *Kin*.— Sometimes without the wing. The latter appears to be used for *n*, the circle for *ki*.

33. *Kal*.— If the separate elements are represented, it is probable the section with the dotted line stands for the *k* and the curved line with the two little teeth for the *l*.

Having submitted samples of my interpretation to Dr. H. T. Cresson of Philadelphia subsequent to the first notice, in *Science*, of my discovery, I am much pleased to learn that he has reached a similar determination as to some of these letter symbols by an independent method. As I was not aware until the publication of the article mentioned, that he was at work on the Maya characters, this agreement in our conclusions is highly gratifying, and serves to strengthen both in the conviction that we are making genuine progress in the solution of this difficult problem.

I give here a few interpretations of groups of compound characters to illustrate the combinations of the letter symbols.

Fig. 2 represents a group of four compound characters in the upper division of Pl. XXII* Codex Troano, to be read in this order: upper left, upper right, lower left, lower right; which we will number in the order given 1, 2, 3, 4.

The following is probably a substantially correct translation: (1) *U-Zabal*, (2) *U-le*, (3) *Cutz*, (4) *2-yaxkin*: "Set (or literally do the setting of) the snare for the turkey on the second day of Yaxkin." I can give no explanation of the little crosses above the symbol for Yaxkin. The prefix to No. 1 and to No. 2 is the character for *u;* the upper character in No. 1 appears to be the symbol for *z* reversed; the band across the lower character the *b* (possibly interchangeable with *p*). The figure below agrees very well with this interpretation.

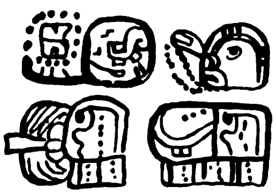

FIG. 3.

The group shown in Fig. 3 is found in the lower division of plate 26 Cortesian Codex. The characters are taken and numbered in the same order as in Fig. 2. No. 1 is supposed with good reason to be a deity symbol, the name however undetermined. Assuming this to be correct, I translate the group as follows: (Deity) *xan yalcab kal-cab*, "As" or "in the name of (the deity) slowly gather the swarm of bees and inclose them in a hive."

The figure below shows a priest wearing the mask of the supposed deity hence we say "as."

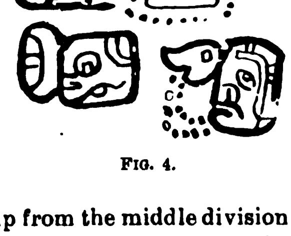

FIG. 4.

Fig. 4 is a group from the middle division of plate XXXII* Codex Troano. The characters are numbered in the same order as the preceding and are translated as follows: *Mulcin ku ci-* (god of death) *xaan;* "Collect together for the temple of the holy god of death palm wood." The picture below represents individuals bearing in their hands what appear to be blocks of wood on each of which is the symbol for *che* "wood."

The little character at the forehead in No. 4 is the symbol

for *aa* which is found in other combinations where it has the same signification.

So far I have found no marks indicating the plural; this may be represented by duplications.

OSTEOLOGICAL NOTES.

BY D. D. SLADE.

THE jugal arch is present in all of the order Rodentia, and is generally complete, although it exhibits many modifications in its composition. Three bones form the arch, which is straight or slightly curved horizontally, while it almost invariably presents a curvature downwards. The position of the jugal therein serves as a determining character in grouping the various families of the order.

The temporal fossa is often little developed, showing feeble energy in the action of the temporal muscle. On the contrary, the pterygoid plates and fossæ are often largely increased in relation to the enlarged development of the muscular insertions. In close connection with these conditions, the coronoid process of the mandible is small, and even rudimentary, while the parts about the angle are largely expanded. The condyle is little elevated and presents, with few exceptions, an antero-posterior articulating surface.

Post-orbital processes of the frontals exist in a few of the families, but there is in no case a corresponding process from the arch. The orbit is never separated from the temporal fossa.

In many of the rodents there is present a more or less extensive dilatation of the infra-orbital foramen, through which passes, in addition to the nerve, that portion of the masseter muscle which has its insertion upon the maxilla. This extends around the back of the jugal process of the maxilla in a pulley-like manner, to an insertion just below the socket of the mandibular præmolar, and thus co-operates with the temporal in moving the mandible in a vertical direction. This attachment of a head of the masseter is peculiar to the order, and explains the use of the vacuity in the maxilla which is oftentimes of vast relative proportions.

Assuming the present classification, all existing Rodentia may be brought into two groups, the Simplicidentata and the Duplicidentata. The first embraces the Sciuromorpha, Hystricomorpha, Myomorpha, and the second, the Lagomorpha.

In the Sciuromorpha, the jugal forms the greater part of the arch, extending forward to the lacrymal, and posteriorly to the glenoid cavity, of which it forms the outer wall, and it is not supported below by a continuation backwards of the process of the maxilla. In the more typical forms there is no enlargement of the infra-orbital opening, while the post-orbital processes of the frontals are characteristic of the family Sciuridæ. The external pterygoid plate is entirely wanting, and there is no fossa.

The jugal arch in the Myomorpha is for the most part slender, and the jugal, which does not extend far forward, is supported by the continuation below of the maxillary process. The zygomatic process of the squamosal is short. No post-orbital process of the frontal exists. The infra-orbital opening varies. In the family Muridæ, especially in the typical forms, this opening is perpendicular, wide above and narrow below, while the lower root of the zygomatic process of the maxilla is flattened into a thin perpendicular plate. Very much the same condition exists in the Myoxidæ, while in the Dipodidæ the foramen is as large as the orbit, rounded, and has a separate canal for the nerve. The malar ascends to the lacrymal in a flattened plate. In close connections with these conditions the coronoid process of the mandible is small and rudimenary, while the parts around the angle of the ramus are much developed.

In the Hystricomorpha the arch is stout. The jugal is not supported by the continuation of the maxillary process, and generally does not advance far forward. The infra-orbital vacuity is large, and is either triangular or oval. The coronary process and the condyle are but slightly elevated above the dental series.

In the Chinchillidæ the jugal extends forward to the lacrymal. In the Dasyproctidæ, Cælogenys is characterized by the extraordinary development of the jugal arch, which presents an enormous vertical curvature, two-thirds of the anterior portion of which, constituting the maxilla, is hollowed out into a cavity which communicates with the mouth. The nerve passes through a separate canal, adjacent to the infra-orbital opening.

In the sub-order Duplicidentata, the jugal arch is well developed. In the family Leporidæ there are large wing-like, post-orbital processes, while the jugal, but feebly supported by the maxillary process, continues posteriorly to aid in the formation of the outer side of the glenoid articular surface, passing beneath the process of the squamosal.

In the Lagomyidæ there are no post-orbital processes, and the posterier angle of the jugal is carried backward nearly to the auditory meatus. The infra-orbital opening in the Duplicidentata is of the usual size. The angle of the jaw is rounded and the coronoid process much produced upwards.

In considering the significance of the jugal arch in the Rodentia, the peculiar vertical curvature downwards, which has already been noted, and which is a decided manifestation of weakness, must be taken into account. This condition is compensated in some of the families by the unusual arrangement made in the distribution of the muscular insertions of the masseter through the infra-orbital opening, by which increased energy is imparted to the powers of mastication, and whereby the action of the mandible is rendered fully equal to the demand upon its efforts.

In those families where the above condition does not exist it is evident that the strength of the arch is still sufficient for the antero-posterior movement of the articulation so peculiar to the Rodentia and so characteristic of the act of gnawing.

The relation of the arch to the neighboring parts must also be remarked. For example, the ascending ramus of the mandible differs according to the food. Elevated in the Leporidæ, it is short in the Sciuridæ, and still shorter in the Muridæ.

In the first the coronoid is broad, projects but slightly, is near the condyle, and far distant from the molar series, while the angle of the jaw is broad and well rounded, as in the Lagomyidæ.

In the other two families, squirrels and rats, the coronoid is feeble, pointed, and placed at equal distances between the condyle and the last molar; thus the masseter does not possess a leverage as advantageous as in the hare. This muscle, however, in the rats has its maxillary attachments much developed, while few fibres spring from the arch — a condition correlative with the feebleness of this last.

Cambridge, June 21.

NOTES AND NEWS.

THE recent publication is announced in *Nature* of the first number of a new monthly journal under the title *Rivista di patologia vegetale*. It is edited by Sigg. A. N. and A. Berlese, and published at Avellino, in Italy; and is to be devoted to the study of animal and vegetable parasites infesting cultivated plants, to the diseases which they cause, and the remedies employed to combat them.

— According to *Nature*, the Port Officer of Mangalore reports that a native craft was overtaken by heavy weather and made for Mangalore, where there is a bad bar with about eight feet of water on it. A tremendous sea was breaking over the bar, so, before crossing it, and while running in, the native skipper opened an oil cask, forming part of the cargo, and scattered it all round in the sea plentifully, with the result that he took his craft across the bar safely, and so saved the vessel and the cargo. The vessel's name was "Mahadeprasad," and she was of 95 tons, bound from Cochin to Bombay. This is said to be the first case on record of a native tindal who has successfully used oil in troubled waters.

— In *Science* of July 8, the closing paragraph of the article by Dr. C. V. Riley, on "The Number of Broods of the Imported Elm-leaf Beetle," should have read: "Our statement upon page 8 was a general one, based upon the observed shortness of the larval life, and upon the fact that the earliest larvæ mature before the end of May, and upon the additional fact that we know that newly developed beetles are found early in June. Prof. John B. Smith, in a paper read before the Entomological Club of the American Association for the Advancement of Science, in August of this year, made the statement that there is but one annual generation in New Jersey. The adult beetles develop from the larvæ which have fed during the summer, entering winter quarters as early as the first week in August. This state of affairs may probably hold in more northern regions, but in Washington it is safe to say that there are two generations, because, as just stated, newly developed beetles (the progeny of those which hibernate) appear in early June. These lay eggs, and, in fact, egg-laying may continue until the end of September, and larvæ have actually been found by Mr. Pergande in October."

— Mr. D J. Macgowan, writing in the *Shanghai Mercury*, gives an account of some remarkable statements made by a group of Chinese traders who lately undertook a mercantile exploration of the interior of Southern Formosa. They started from Lamalan, which Mr. Macgowan takes to be Chockeday of the charts, and in seven days reached their objective point, Hualin Stream. They lodged in stone caverns, and the chattering of monkeys and the sounds of insects seemed to them "appalling and indescribable." The region was so "weird" that it reminded them of "legends of the kingdom of hobgoblins." Among the trees were some of "prodigious girth, forming a vast forest." These trees are said to measure more than ten outstretched arms. A tree said to flourish in the same forest is described as bearing "flowers, red and white, which are larger than a sieve, and of extraordinary fragrance." Mr. Macgowan adds: "Mr. Taylor, while searching for orchids, heard of these majestic trees and huge flowers, which he inferred, from what natives said, were epiphyte orchids. I am moved to make known this sylvan discovery in the hope that, pending the exploration of this *terra incognita* by our botanists, Dr. Henry or Mr. Ford, residents in Formosa will take measures to provide those naturalists with specimens of flowers, seeds, leaves, and bark of the trees concerning which the Chinese have excited our curiosity."

— "The New Decimal Association, whose headquarters are at Botolph House, Eastcheap," says the *London Daily Graphic* of May 14, "has memorialized the Lords of the Committee of Council on Education on the desirability of taking an important step in connection with the introduction of the metric system in this country. The May examinations of the Science and Art Department are known through the length and breadth of the land, and much has been done by means of these examinations to popularize and extend technical study. The memorial which has been presented recommends that in certain of the science examinations alternative questions be given in future, based on the metric system of measurement, which may be taken at the option of the candidate in lieu of questions based on feet and inches In this way the large and intelligent class of candidates for certificates of the department will be induced to learn the metric system. The Committee of Council on Education has already ordered that the principles of this system should be taught in the higher standards of all elementary schools; and one of the steps taken by the school boards of London and other towns in consequence of this order has been to furnish the pupil teachers and advanced scholars with boxwood rules having a decimalized inch scale and a metric scale in juxtaposition. In addition to this, colored wall-charts of the metric weights and measures are used, and in this way the rising generation will to a great extent be prepared for the introduction of these weights and measures in future.

— The second annual geological expedition of the State University of Nebraska, undertaken by a party of six, left Lincoln for the field, June 21, 1892. This is known as the Morrill Geological Expedition, in honor of Charles H. Morrill, regent of the State University, whose liberality makes this work possible. The primary object of the expedition is the collection and preservation of geological specimens in general, but more particularly the palæontological forms for which the State and immediate surroundings are famous. The chief objective points are the Tertiary deposits of the White and Niobrara Rivers, and the Bad Lands of Nebraska, Wyoming, and South Dakota. The expedition is provided with tents, — furnished by Governor Boyd, — with teams and heavy covered wagons of the prairie-schooner type, and with apparatus, camping equipment, and provisions for the summer. The party consists of six members, — exclusive of guide, — Mr. Thomas H. Marsland, Frederick C. Kenyon, Arthur C. Morrill, and Harry H Everett, all of the State University of Nebraska, and James H. Haines of Iowa College, together with Erwin H. Barbour, acting State geologist, as professor in charge. The "Fossil Corkscrew," or Daimonelix, beds were visited first, and some tons of these extraordinary new fossils — noticed and figured in *Science*, February, 1892 — were obtained. Native lumber and hay for packing are carried, and specimens are boxed as found, and delivered at the nearest station or siding. At the close of the expedition these scattered collections will be brought together and delivered at the State University in cars, which the railroad companies have generously offered for that purpose.

— The eighth annual report of the Wisconsin Experiment Station devotes a large share of space to questions relative to ensilage. One chapter is devoted to a careful study, by F. H. King, of the construction and filling of silos. Mr. King, having visited 93 silos in Missouri, Michigan, Ohio, and Illinois, and several farmers while filling their silos, in order to obtain data for this chapter. Mr. King concludes that a stone silo, properly constructed, will keep the silage as well as a wooden one, but that it will be necessary to renew the cement lining frequently, or else to whitewash it with fresh cement every year, as the acids of the silage soon soften the cement. He finds that lath and plaster is a failure as a silo lining, both because of the softening of the plaster and the liability to injury with the fork in handling the silage. Of the wooden linings, that made by two thicknesses of boards with tarred paper between, all nailed firmly together, is showing greatest durability; but all wooden linings rot soon unless well ventilated. Painting the lining tends to hasten decay instead of preserving it. From an experiment in feeding corn silage in comparison with dry corn fodder, the following conclusions are reached: 1. A daily ration of four pounds of hay and seven pounds of grain feed, with corn silage or field-cured fodder corn *ad libitum*, fed to twenty cows during sixteen weeks, produced a total quantity of 19,813 pounds of milk during the silage period, and 19,801 pounds of milk during the fodder-corn period. 2. When we consider the areas of land from which the silage and fodder corn are obtained, we find that the silage would have produced 243 pounds more milk per acre than the dry fodder, or the equivalent of 12 pounds of butter. This is a gain of a little more than three per cent in favor of the silage.

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A PLEA FOR A BROADER BOTANY.

BY L. H. BAILEY.

THE science of botany, as ordinarily considered and taught, has not laid hold of the full amount of territory to which it is entitled, and it has not, therefore, reached its full measure of usefulness. Strictly speaking, botany is the science of plants, but by general consent it appears to have dwarfed itself into a science of wild plants; or if it deals with cultivated plants they are such as fall to the care of botanical gardens, or, in other words, those which are cultivated for the sole purpose of maintaining a collection. It is not strange that in the earlier days botanists should have eliminated from their domain the whole realm of cultivated plants, for cultivation then meant little else than the maintenance and improvement of plants for merely economic purposes, and there was little science of cultivation. But now that the teachings of evolution have thrown a new purpose into the study of all natural objects, cultivated plants have acquired a fascinating interest from the abundant light which they throw upon variation and descent. In fact, aside from paleontology, there is no direction in which such abundant material can be found for the study of evolution as in cultivated plants, for in nearly all of them the variation is fully as great as in domesticated animals, while the species are very many times more numerous; and, by the fostering aid rendered by man, the accumulative effects of modified environment and selection are much more quickly seen — and therefore more intelligible — than in wild plants. My nearest neighbor, who is a paleontologist, and myself, a horticulturist, compare our respective fields of study to the decay and burning of a log. In both decay and burning the same amount of work is finally accomplished and the same amount of heat is evolved, but one process requires years, perhaps a century, for its accomplishment, and the other requires but a few hours. Cultivated plants afford within definite periods of time as much variation and progression as their wild prototypes exhibit in ages. So the garden is one of the best places in which to study evolution. It is a common opinion, to be sure, that the variation of cultivated plants is anomalous and uninstructive because influenced by man, but this is wholly erroneous. I have yet to find a variation in cultivated plants which can not be explained by laws already announced and well known. It is strange that one can ever believe that any variation of natural objects is unnatural!

But wholly aside from the fascinations of pure science, cultivated plants and cultivation itself demand the attention of the botanists, for horticulture is nothing more than an application of the principles of botany. Just now, mycology is making important additions to horticultural practice, but there are greater fields for the applications of an exact science of plant physiology, whenever that science shall have reached a proportionate development. In short, the possibilities in horticulture, both in science and practice, are just as great as they are in the science of botany upon which it rests; and inasmuch as it is absolutely impossible to separate horticulture and botany by any definition or any practical test, the two should go together in an ideal presentation of the science of plants. Horticulture belongs to botany rather than to agriculture.

The ideal chair or department of botany, therefore, should comprise, in material equipment, laboratories, botanic garden, green-houses, orchards, vegetable and ornamental gardens, all of which should be maintained for purposes of active investigation rather than as mere collections; and I am sure that no department of botany can accomplish the results of which the science is capable until such breadth of equipment is secured. I am aware that there are difficulties in such a comprehensive field, but the only serious one is the lack of men. Botanists, as a rule, care little for gardens and cultivated plants, and horticulturists are too apt to undervalue the importance of scientific training and investigation; but the time cannot be far distant when men shall appear with sufficient scientific and practical training to appreciate the needs of the whole science and with enough executive ability to manage its many interests. Such men are no doubt teaching in some of our colleges to-day, were the opportunity open to them. One cannot be a specialist in all or even several of the many subjects comprised in this ideal, but he may possess the genius to encourage and direct the work of other specialists. The first need is the opportunity, for there is not yet, so far as I know, an ideal chair of botany in existence, where the science can be actively studied in its fullest possibilities and then be presented to the student and the world.

Cornell University.

THE LAWS AND NATURE OF COHESION.

BY REGINALD A. FESSENDEN.

DESIROUS of finding some relation between the conductivity of metals and their other physical properties, the writer, several years ago, began to tabulate all the data he could find. Realizing the uselessness of comparing the properties of substances whose natures are essentially different, as wood and iron, it was decided to confine the work to the elementary substances. It was found that the only elements whose properties were at all well known were those of the five chemical groups comprising the following metals: I., iron, nickel, cobalt, platinum, osmium, iridium; II., sodium, copper, silver, gold; III., magnesium, zinc, cadmium, mercury; IV., aluminium, thallium, indium, gallium; V., silicon, tin, lead.

The data collected were not very concordant, but when they had been compared and the most probable values taken, laying due stress on the purity of the substances examined and the standing

of the observer, various regularities or laws were at once apparent, and it is for the purpose of pointing out one of these that the following paper has been written.

This piece of paper, taken as a whole, has certain properties, a certain size, a certain weight, a certain motion, and is the seat of a certain force which attracts other ponderable bodies to it. A single atom of matter has its weight, motion, size, and force. The weights of the atoms form the basis of electrometric chemistry, their motion that of the kinetic theory of heat. To their size less attention has been paid, we have only Mendelejeef's curve and certain experiments of Roberts-Austen, who has showed that the tensile strength of gold is weakened, not in proportion to the weight of the metal alloyed with it, but to the volume, in the same way as ten lumps of gravel weaken a casting more than ten grains of sand. Of the force — the force of cohesion — still less is known, in fact absolutely nothing, and the object of this note is to point out what the nature of this force is and what its laws are.

In its early youth science was riotously extravagant of ethers, and any puzzling phenomenon was considered warrant enough for the creation of a new one. As it has grown older it has grown also more economical, until at the present day the scientist who should ask for an appropriation of a new ether, to help him out of a difficulty, would be pounced upon. For this reason, if no other, we will confine ourselves to examining the various means by which our present ether has been supposed capable of producing the forces which cause cohesion.

1. Gravitation. There have not been wanting eminent scientists who have considered that gravitation could account for cohesion, and there have been many ingenious theories proposed, for instance that of Watts, who supposed that (since the effects of gravity on the moon's path may be supposed to consist of two parts, one independent of the shape of the earth and varying inversely as the square of the distance, the other dependent on the shape and varying inversely as the cube of the distance) if the atoms were of irregular shapes it might account for the effects. But no theory with gravitation as its basis will hold, first, because the effects are much too small; second, because, as we shall see, the cohesive force is totally independent of the weights of the atoms and depends on the size only.

2. Condensation and rarifaction of the ether caused by the motion of the atoms. If we hold a pith ball near a tuning fork the pith ball will be attracted up to a certain distance, and will then be repelled if brought closer. This theory has been a favorite with many, but, as such an attraction would vary with the motion of the atoms in a way that we know the force of cohesion does not, it also must be dismissed.

3. Electricity. That the force of cohesion was due to electricity has long been vaguely suspected. On the same principle apparently that electricity was considered to be the cause of life, *i.e.*, "Life is a wonderful thing and unexplainable, electricity is a wonderful thing and unexplainable; therefore electricity is life" — the argument being possibly aided by an instinctive recollection of the Athenasion creed, which states that "there is only one incomprehensible." The writer is not aware that any evidence in favor of this theory was ever offered, so it was probably merely a guess.

Having rejected theories 1 and 2, we may see how the facts agree with the theory that cohesion is an electrostatic effect.

If we electrolyse a solution of silver nitrate, we know from Faraday's work that every atom of silver deposited on the electrodes carries over a certain quantity of electricity. This quantity is always the same, no matter how or when or where we perform the electrolysis, and this quantity seems to be related to the atoms in the same way as a pint of water to a pint measure. We may calculate the quantity on each atom in the following way. One cubic centimeter of silver weighs about 10.5 grammes. One coulomb is carried over by every 1.12 milligrammes of silver deposited, therefore the charge on the atoms contained in one cubic centimeter of silver is $\frac{10500}{1.12} = 10^4$ coulombs.

As the sizes of the atoms vary from 10^{-7} to 10^{-8} centimeters in diameter, and silver is a small atom (½ the size of potassium), we may call its size 10^{-8} centimeters. In a cubic centimeter of silver then there would be 10^{24} atoms, which would give as the charge on each atom $10^4 + 10^{24} = 10^{-20}$ coulomb. The capacity of an atom having a diameter of 10^{-8} centimeter is $\frac{10^{-8}}{18 \times 10^{11}} = 0.5 \times 10^{-20}$ farads.

The potential on each silver atom will therefore be about one volt. We may look at the cubic centimeter of silver as being made up of planes, each plane consisting of one layer of atoms. The distance between the centres of any two layers would be 10^{-8} centimeters. The potential on the atoms being one volt, the attraction between any two layers would be

$$\frac{4.5 \times 10^{-11} \times 1^2}{10^{-16}} \text{ grammes per cm}^2 = 4500 \text{ kg. per. cm}^2 = \text{calculated tensile strength of silver} = 45 \text{ kg. per sq. mm.}$$

From Wertheim's results we have observed tensile strength of silver 38 kg. per sq. mm. That the calculated and observed results should be so close is of course only a piece of good fortune. We had no right to expect it, as the data upon which the calculation is based are not known with sufficient accuracy. Still, the result is a remarkable one, and places beyond question the fact that the known electric charges on the atoms can produce effects of the same order as those observed.

Having shown this, we may follow up the theory by investigating in what way the cohesion of the metals would vary if this were the case. Evidently (since every atom, large or small, has the same quantity of electricity, and the larger the atoms of a metal the farther away the centres of the atoms would be) the cohesive force should be inversely proportional to some power of

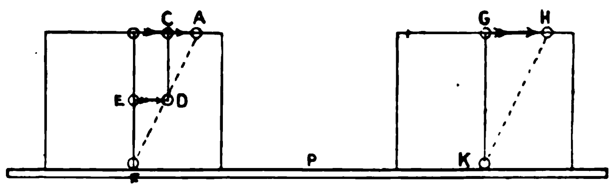


FIG. 1. FIG. 2.

the size (or atomic volume, as it is called, and which is got by dividing the atomic weight by the density of the substance). The following table shows this to be the case. In the first column are the names of the metals, in the second their relative sizes, or atomic volumes, in the third their rigidity, as given by Mr. Sutherland in the *Philosophical Magazine* of August, 1891: —

I.	II.	III.	IV.	V.
Iron	7.1	750 × 10⁹	483 × 10⁹	550 × 10⁹
Copper	7.1	430	483	550
Zinc	9.2	350	314	340
Silver	10 2	280	270	270
Gold	10.2	270	270	270
Aluminium	10.4	250	250	260
Magnesium	14.	150	154	143
Tin	16.	136	122	100
Lead	18.	84	100	83
Cadmium	13.			170

As will be seen, the agreement is perfect, with the exception of iron, and those who are familiar how greatly the properties of iron are changed by the least particle of impurity will possibly agree with me in thinking that absolutely pure iron would be less rigid; in fact, some recent experiments show that it is so, being nearer 600 than 750; but I have not inserted this value, because a comparison with a set of observations made by one observer at one time and by one method would have a greater value than comparison with a lot of picked results from different observers.

Assuming the electrostatic theory, we can easily calculate the exact function which rigidity should be of the atomic volume in the following way.

Suppose Figs. 1 and 2 to represent two cubic centimeters of different elements, of which the atoms of one are twice the diameter of the other, or, to put it more accurately, the distance between centres of atoms is twice as great in the one case as in the

other. Let 1 contain the smaller atoms. Suppose one face made fast to the plank p, and both sheered slightly till they have the position shown by the dotted lines. It is evident that the ratio of work done in bringing the atom at G over to H to that done in bringing E to D, or C to A, will be the mean ratio of the force of attraction between K and G to that between E and F. This latter varies inversely as the square of the distance, according to the well-known electrical law, and, consequently, as the distance $G\,K$ is twice that of $E\,F$, the work done in moving E to D will be four times that done in moving G to H. Again, in Fig. 1 there will be 2^3 as many atoms to be displaced as in Fig. 2, so that, on the whole, there will be $2^2 + 2^3$ as much work done in displacing the cube in Fig. 1 as in Fig. 2. In other words, the rigidity will vary inversely as the fifth power of the distance between the centres of the atoms, or as (atomic volume)$^{\frac{5}{3}}$. Col. IV. gives the results calculated on this theory. As will be seen, they agree fairly well, as well as could be expected, considering the fact that we have left out one factor. This is the variation of rigidity with temperature, and as it would be obviously unfair to compare lead and silver at 600° C., it is obvious that our calculated results should only be applied when the metals are at some one point, say, at a temperature which is $\frac{1}{4}$ the temperature of their melting-point. As those metals having the greatest atomic volume, as a rule, melt at lowest temperature (though there are many exceptions to this) we may make a rough sort of formula, which shall give the rigidity at ordinary temperatures by multiplying again by the atomic radius, so we get (atomic volume)^2 as the rate at which

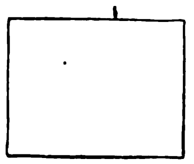


FIG. 3.

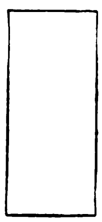


FIG. 4.

rigidity varies with size of atoms. Col. V. is calculated in this way from the rough formula :—

$$\text{Rigidity} = \frac{28 \times 10^{12}}{(\text{atomic volume})^2} \qquad \text{Equation I.}$$

The formula for Col. IV., and the more correct one, if we neglect variation of rigidity with temperature, is

$$\frac{12560 \times 10^9}{(\text{atomic volume})^{\frac{5}{3}}} \qquad \text{Equation II.}$$

The other moduli are related to that of rigidity. For if we represent Young's modulus by $\frac{1}{a}$, then the modulus of rigidity is represented by $\frac{1}{2(a+b)}$ and the bulk modulus by $\frac{1}{3(a-2b)}$, where b represents the lateral shortening accompanying the longitudinal lengthening a. So if b bears to a any constant ratio, then Young's modulus and the bulk modulus will each be some fraction of the modulus of rigidity. The continental writers, at least a good many of them, hold that $\frac{b}{a} = \frac{1}{4}$. Kelvin, Tait, and Stokes say there is no relation. On the one hand, it is certain that $\frac{b}{a}$ is not constantly equal to $\frac{1}{4}$. On the other hand, it does not follow that there is no relation between the two, and the evidence which has been brought to prove this has no value, for we have no right to argue from the facts that in india-rubber $\frac{b}{a} = \frac{1}{2}$, while in cork $\frac{b}{a} =$, say, $\frac{1}{100}$, that $\frac{b}{a}$ does not have any constant ratio in metals. The laws which govern the moduli of compounds and non-homogeneous substances like india-rubber and cork are not the same as those which govern homogeneous substances like gold and silver.

The following is a table of the metals and their Young's moduli. Col. I. contains the observed moduli taken from Sutherland's paper, and Col. II. contains the calculated values from the equation.

Equation III. Young's modulus $= \frac{78 \times 10^{12}}{(\text{atomic volume})^2}$ (corresponding to Equation I.).

Metals.	I.	II.
Iron	$2{,}000 \times 10^9$	$1{,}560 \times 10^9$
Copper	1,220	1,560
Zinc	930	920
Silver	740	750
Gold	760	750
Aluminium	680	690
Cadmium	480	465
Magnesium	390	395
Tin	420	295
Lead	190	235

There is only one metal which does not agree with theory, and that is tin (iron, of course, on account of its impurities does not, but we know that, as we obtain iron more pure, we find its rigidity less, so there is very little doubt but that if it were absolutely pure the agreement would be closer). But it is easy to show that the observed results of tin are wrong. For the rigidity is given as 136×10^9 and the Young's modulus as 420×10^9. Therefore, if we represent Young's modulus by $\frac{1}{a}$, then $\frac{1}{2(a+b)} = \frac{136}{420}$. Solving this we get $b = .55\,a$. Therefore the bulk modulus $\frac{1}{3(a-2b)}$ is negative, and the more tin is compressed the larger it swells, a result which is absurd. This will emphasize the fact that the agreement between theory and experiment is as close as that between the experiments themselves.

It will be noticed that the ratio-rigidity, Young's modulus, is about $\frac{28}{78}$. Therefore, as $\frac{1}{2(a+b)} = \frac{1}{2.7}$, Poisson's ratio for these metals is, on the average, 0.35. Therefore the bulk modulus = 1.1 times Young's modulus, which agrees with the only datum I find in Everett, i.e., Wertheims's figures for brass, which gives the ratio 9 48 : 10.2 = 1.08, very closely. All these moduli must contain the atomic volume to the same power, but this is not the case with the tensile strength; for, according to this electrostatic theory of cohesion, we may look at a wire as made up of thin discs, each disc consisting of a layer of atoms. The attractive force between any two such layers would vary inversely as the square of the distance between them and directly as the number of atoms in a layer. Combining these we find that it would vary as the fourth power of the atomic radius, or as (atomic volume)$^{\frac{4}{3}}$, making no allowance for the effect of temperature on the tensile strength. The following table gives in Col. I. the observed tensile strengths, taken from Wertheim for wires 1 millimeter in diameter; in Col. II. the atomic volumes of the elements, raised to the $\frac{4}{3}$-power; and in Col. III. the calculated tensile strengths, as found by the formula.

Equation IV. Tensile strength $= \frac{638}{(\text{atomic volume})^{\frac{4}{3}}}$ in kilograms for wires 1 millimeter in diameter.

Metal.	I.	II.	III.	IV.
Iron	65	13.7	48	2,000 (?)
Copper	41	13.7	48	1,327
Platinum	35	17.8	36	1,800 (?)
Zinc	15.77	19.3	33	690
Silver	29.6	22.2	29	1,233
Gold	28.46	22.2	29	1,313
Aluminium	18	23.2	27	898
Tin	3.40	41	15	504
Lead	2.36	47.8	13	600

Col. IV. contains the melting-points in degrees Centigrade from absolute zero. Here we have to deal with a much more

complicated phenomenon than that of rigidity. Rigidity is simply a function of the cohesive force. The tensile strength of a substance depends not only on the cohesive force of the metal, but also on its ability to resist flow. If a metal did not flow before being pulled apart, there is no doubt but that its tensile strength would be proportional to the $\frac{4}{3}$-power of the atomic volume. As, however, it does flow, and the amount of flow is not simply proportional to the diminishing of the cohesive force, we have to make a fresh allowance for it. In all the metals the melting-point is reached when the linear expansion has amounted to about 2 per cent. So when the cohesion has diminished about 4 per cent the atoms no longer hold the same relative positions, but one can slip in and take the place of another. So at equal distances from their melting-points only can the tensile strength be proportional to the $\frac{4}{3}$-power of the atomic volume. Consequently this ratio can only hold good with substances which have approximately the same melting-point. On examining the table, it will be seen that as copper, gold, and silver have approximately the same melting-point, the ratio does hold good with them. The same with tin and lead. Aluminium and zinc, which should be, the one slightly weaker, the other slightly stronger, than silver, have a melting-point about one-half that of gold and silver, and they have about half the strength at the temperature of comparison which they should have. The melting-point of iron and platinum is higher than that of gold or silver, and consequently their tensile strength is greater. The flow of a metal depends on two things, the cohesive force and the kinetic energy of the atoms. What function the flow is of the temperature, as reckoned in fractions of the temperature at which the substance melts, it is hardly worth while to go into now. If we suppose it directly proportional (though we may feel fairly certain it is not as simple a function) so that, at the same temperature, a metal melting at half the temperature that another does flows twice as easily, we get the following table, where Col. I. contains the observed tensile strengths, and Col. II. the calculated ones: —

Metal.	I.	II.
Iron	65	74
Copper	41	48
Platinum	35	48
Silver	29.6	29
Gold	28.5	29
Aluminium	18	18
Zinc	15.7	16
Tin	3.4	5
Lead	2.36	4

I have not been able to find any data on the tensile strength of magnesium. Theory gives about 9 kilograms for a wire 1 millimeter in diameter. It would be interesting to find if experiment confirms this.

If, when we have met with a new phenomenon in a substance, and are able to show that a certain property already known to exist in the substance is capable of producing effects of the magnitude observed, and that the phenomenon obeys the same laws as it would if it were caused by the already known physical property, we are to a certain extent justified in supposing that this property is really the cause of the phenomenon in question, and in applying our knowledge still further, we have seen that the charges which we know the atoms have on them are able to give effects of the same size as those observed in experiments on tensile strength, and that the various moduli follow the same laws as they would if cohesion were an electrostatic effect, and we may now apply our formula to other and less-known phenomena.

The velocity of sound in a wire is given by the formula: —

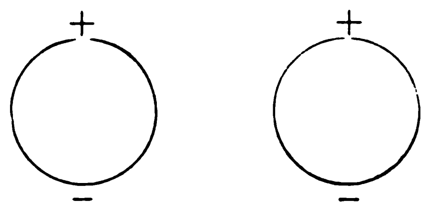
$$\text{Velocity} = \left(\frac{\text{Elasticity}}{\text{Density}}\right)^{\frac{1}{2}}.$$

Elasticity here means Young's modulus, the formula for which, as we have seen, was constant ÷ (atomic volume)^{2}, and atomic volume is atomic weight ÷ density, so we have velocity of sound in wire $= \left(\frac{\text{constant}}{\text{atomic weight} \times \text{atomic volume}}\right)^{\frac{1}{2}}$, the constant being 78×10^{12}. The following table gives in Col. I. the velocities of sound in wires of a number of metals which have been tested, and in Col. II. the calculated velocities for these and for other metals which have not yet been tested.

	I.	II.	III.
Silver	2.61×10^{5}	2.7×10^{5}	100
Copper	3.56	4.1	110
Gold	1.74	1.9	136
Alumin.		5.1	200
Magnes.		4.8	275
Zinc		3.6	374
Cadmium		2.3	450
Tin		2.0	878
Lead	1.23	1.4	1300

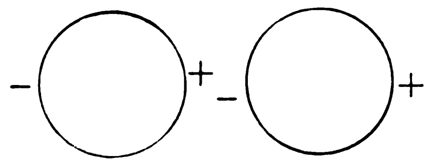
Col. III. gives the electrical resistance, silver being taken as 100, and it may be noticed that in any one group of metals the conductivity varies directly as the velocity of sound, and in passing from one group to another, by multiplying the conductivity by the valency we get proportionate values for all the metals. The same holds good for the heat conductivity. No close agreement can be expected here, for there are too many things to be taken into account. It is merely mentioned here because the fact of there being a relation between the velocity of sound and the conductivity for heat and electricity throws a light on the nature of these phenomena. This will form the subject of a separate paper. It may be asked *how* an electrostatic force can produce such effects. If the atoms are all similarly charged either + or − they would repel each other and not attract. The explanation is probably this: The atoms, if we may call them so, of electricity are not infinitely smaller than the atoms of matter. When an atom is neutral it does not mean that it has no charge but that it has equal quantities of both kinds of electricity. The resultant effect of these charges on a body at a distance is zero, it behaves as if it had no charge, as shown below, in *A*.

A



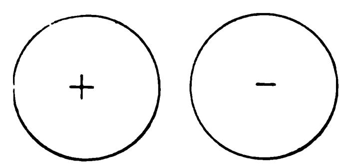
If the atoms be brought close together there is a state of unstable equilibrium, and the effect is that either the charges move on the surface of the atoms or the atoms themselves move so that the atoms attract each other, as in *B*. Consequently all atoms

B



neutrally charged attract each other. If nothing further happens the attraction is simply cohesion. If, however, any third substance connects the two outside parts of the atoms and so enables these parts to neutralize each other we have chemical combination, and the two atoms when separated show opposite charges, as in *C*.

C



Whether we accept the electrostatic theory of cohesion or not, from the above tables of moduli, the following laws are evident.

I. In any two metals the force of cohesion varies inversely as the square of the distance between the centres of their atoms.

II. In any one metal the force of cohesion varies inversely as the square of the distance between the centres of its atoms.

We may expect these facts to be of great use in the study of the properties of matter. For, knowing the size and weight of the atoms and the velocity with which they move, all that was wanting to enable us to calculate the behavior of the atoms of matter, in the same way as we do the motions of the planets, was a knowledge of the laws of the force which holds them together; and, from the evidence given above, I have no doubt that you will agree with me in saying that we have at least made a beginning in that direction.

A few words might be said about Poisson's ratio. It is, as I said, not fair to argue from the behavior of cork or india rubber that there is no relation between longitudinal extension and lateral contraction, or between a and b. When we compress a cork we are not compressing the substance which forms the cork any more than we are compressing a piece of paper when we crumple it up in our hand. A cork is like a dry sponge, and when we squeeze a sponge up in our hand we are simply doubling up the cell-walls, not compressing the substance of the sponge. The only way in which we can determine the compressibility of cork is to soak it in ether or some substance which fills all its pores and then subject it to hydrostatic pressure. In the same way when we stretch india rubber, or ivory or jelly, the longitudinal extension of the piece of rubber is not in the least a measure of the longitudinal extension of the substance of the rubber. All such substances are made up of two parts; rubber, for instance, of a hard elastic skeleton, insoluble in most solvents, and of a soft plastic substance, soluble in many solvents, by use of which the two parts may easily be separated, similarly ivory and jelly. Let us take a square cell as in Fig. 3, the walls of which are of elastic material and the contents an incompressible plastic substance. Suppose it to be extended till its length is 4 centimeters and its breadth and thickness each 2 centimeters, as in Fig. 4. The total area of cell-wall is 40 square centimeters, and the total volume of incompressible contents is 16 cubic centimeters. Imagine the cell to be released, it will regain its position as in Fig. 3, and form a cube of side 2.52 centimeters. In this case, the volume being the same, the cell area will be 38.1 square centimeters. So we find that by stretching the cell till its length was 60 per cent greater than before, we have only had to stretch the cell-walls 5 per cent. This gives us the explanation of the well-known fact that stretched rubber contracts when heated. For if we heat the cell shown in Fig. 4 the incompressible contents will expand and tend to make the cell-walls take that shape in which they can hold the most. This is obviously that of the original cube, therefore the result will be a contraction.

Of course the formulæ, derived from this theory of cohesion, give us the means of calculating the physical properties of metals which have never been examined, or even discovered. For example, it shows us that we have at our disposal a metal far superior to any metal yet known, one which is stronger than iron, lighter than aluminium, and a better electrical conductor than silver. Aluminium, in spite of its lightness, is too weak mechanically and too poor a conductor to be used in many cases. But this new metal is four times as strong as aluminium, and is twice as good a conductor of electricity. The metal referred to is glucinum or beryllium. All that is known about it is that it has an atomic weight of 9.1 and a density of 1.7 to 2, the exact figures not being known. But from these scanty data we can deduce the following figures:

Metal	Rigidity	Tensile st'gth	Conductivity	Sp. gr.
Alumin.	250×10^9	18 Kgms	50	2.75
Silver	280	27	100	10.5
Iron	750	42-65	14	8
Calculated for Glucinum	1300	65	105	2

We also see why diamond is so hard, and that there is only one other thing that might possibly scratch it, and that is a crystal of manganese. With the exception of glucinum, none of the other metals, either discovered or to be discovered, are likely to be any better than those we have now.

NOTES ON LOCAL HEMIPTERA-HETEROPTERA.

BY E. B. SOUTHWICK, PH.D.

IN the CORISIDÆ *Corisa Harrisii* Uhl. is very common in our park lakes, and the drag-net brings many of them to land at every haul. Another species as yet undetermined is about one-third the size of *Harrisii*, and equally abundant.

In NOTONECTIDÆ *Notonecta undulata* Say. is very common. This was at one time known as *variabilis* Fieb., a name quite appropriate, for they are variable to a marked degree, some of them being nearly white, while others are very dark. *Notonecta irrorata* Uhl. is also common, and is a very beautiful insect, and more uniform in coloration.

In NEPIDÆ *Ranatra fusca* Pal. Beauv. is our only representative, as far as my observation goes; this was at one time known as *R. nigra* H. Schf.

In BELOSTOMATIDÆ we have two species. *Benacus griseus* Say., that giant among Hemiptera. This much-named creature has been known as *B. haldemanus* Leidy, *B. harpax* Stal., *B. ruficeps var.* Duf., *B. distinctum* Duf., and *B. augustatum* Guer.; but at last has settled down to *B. griseus*, which name, I hope, gives credit where it belongs. *Zaitha fluminea* Say. is very common in our lakes, and the females are often taken with their backs completely covered with eggs, deposited in regular rows upon the elytra; at the same time the young of all sizes will be brought up with the drag-net.

In the family HYDRODROMICA and sub-family SALDIDÆ I have but one representative species, *Salda orbiculata* Uhl., and it is exceedingly rare.

In the sub-family HYDROBATIDÆ I have taken three species, viz., *Limnoporus rufoscutellus* Lat., *Limnotrechus marginatus* Say., and *Hygrotrechus remigis* Say; they are all about equally common on the waters of our lakes and in ditches and pools.

In the family REDUVIDÆ the sub-family PIRATINA is represented by *Melanolestes picipes* H. Schf., which is quite common under stones along with *Carabidæ*.

In the sub-family REDUVIINA we have three species. *Diplodus luridus* Stal. is very common with us, but in Professor Uhler's list it is only given as from Mexico. *Acholla multispinosa* is also common; this has been known as *A. sexspinosus* Wolff., and *A. subarmatus* H. Schf.

Sinea diadema Fabr. is not rare with us; this insect has had a number of names, and has been studied as *S. multispinosus* De G., *S. hispidus* Thunb., and *S. raptatorius* Say. I have a pair of insects from this State labelled *Harpactor cinctus* Fabr., which are probably what is now known as *Milyas cinctus* Fab. They are of a beautiful pinkish-white color, and have the limbs banded with black.

In the sub-family CORISINA three species of *Coriscus* are represented. *Coriscus subcoleoptratus* Kirby, a very common and curious insect, and formerly known as *C. canadensis* Prov., *C. annulatus* Reut, which is very rare, and *C. ferus* Linn, rather common.

In the family PHYMATIDÆ the sub-family PHYMATINA is represented by that very common and curious insect *Phymata Wolffii* Stal. *Phymata erosa*, which is quoted as common throughout the State of New Jersey, I have never found here.

In the family TINGITIDÆ and sub-family TINGITINA I have *Corythuca arquata* Say. as one of the most common. This species of Tingis is found on the butternut, and was at one time known as *Tingis juglandis* Fitch, and Dr. Riley found it on the white oak.

Corythuca ciliata Say, formerly known as *Tingis hyalina* H. Schf., is, I believe, the one so common on the button-wood, *Platanus*. I have a species taken from the paper mulberry *Broussonetia* and another species from *Stophylea*, both new to me.

In the family ACANTHIDÆ and sub-family CIMICINA we have *Acanthia lectularia* Linn., which is very abundant and well distributed all over our city. In the family CAPSIDÆ we are quite well represented. *Plagiognathus obscurus* Uhl. is very common. *Episcopus ornatus* Reut is quite rare; I have only taken about a dozen specimens. *Garganus fusiformis* Say is rather common, and *Hyaliodes vitripennis* Say is exceeding rare.

Capsus ater Linn. is also rare, but is conspicuous on account of its shining black color. *Orthops scutellatus* Uhl. is very rare indeed; I have only taken about half a dozen specimens. *Comptobrochis grandis* Uhl. is also very rare. *Poecilocapsus goniphorus* Say. is very common; this has been known as *P. dislocatus* Say. and *P. melaxanthus* H. Schf. *P. lineatus* Fabr. is more common than *goniphorus*, and destroys a great variety of plants. *Poeciloscytus basalis* Reut., formerly known as *P. sericeus* Uhl., is also common. *Lygus pratensis* Linn., which much resembles the last, is exceedingly common; this was formerly known as *L. lineolaris* Pol. Beauv, and *L. oblineatus* Say. *Calocoris rapidus* Say. is common, and was formerly known as *C. multicolor* H. Schf. *Neurocolpus nubilis* Say. is very rare with us; I have but three specimens representing it. *Phytocoris eximius* Reut. is also very rare, and a species of *Phytocoris*, not determined, more common. *Lopidea media* Say. is very rare, as is *Resthenia insignis* Say. *Collaria meilleurii* Prov., which Uhler gives as *Trachelomiris meilleurii* Prov., is quite rare. *Leptopterna dolobrata* Linn. is common everywhere where there are grass and weeds. *Miris offinis* Reut., formerly known as *M. instabilis* Uhl., is not common. *Trigonotylus ruficornis* Fall. is rare with us, making about twenty species of CAPSIDÆ taken here, which is probably only about one-third of the species that occur with us.

OBSERVATIONS AT BOSSEKOP.[1]

THE close connection between the Aurora and magnetism induced Herr O. Baschin to accompany Dr. Brendel to Bossekop for the purpose of observing this phenomenon. On January first of this year they entered the Alten Fiord, at the end of which lies Bossekop. It is built on the slope of one of the raised beaches so common on the shores of the fiord and in the adjacent valleys. An elevation of the shore amounting to 43 inches is said to have taken place during the last fifty years, but the calculations are not beyond suspicion. Dr. Brendel succeeded in obtaining photographs of different forms of the Aurora, the only ones at present in existence. Violent magnetic disturbances have often been observed during displays of the Northern Lights, and the close relation of these phenomena is further demonstrated by the fact that the centres of the arcs of light lie on the magnetic meridian, and that the corona, the most splendid form of Aurora, lies in the magnetic zenith. The most remarkable disturbances took place on February 14, accompanied by an unusually gorgeous display of the Aurora, when the magnetic declination was observed to vary more than 12° — the greatest deviation ever noticed — within eight minutes. At the same time the disturbances in Europe and North America were so great that most of the self-registering instruments were unable to record them. It is not possible at present to determine with certainty the cause of these striking phenomena, but it seems probable that the great sun-spot, seventeen times as large as the surface of the earth, which was at the time visible even to the naked eye, was connected with the disturbances mentioned.

The meteorological observations also presented much that was interesting. The temperature on the west coast of Norway does not fall nearly so low as might be expected in such high latitudes. Even at the North Cape the mean of the coldest month is only 23° F., whereas in West Greenland on the same latitude the temperature sinks every winter to — 40°. As, however, the distance from the coast increases, the temperature falls rapidly. The minimum observed at Gjesvar, near the North Cape, is — 2° F.; at Bossekop, 33 miles from the open sea, — 22°; and at Karasjok, further south but 120 miles from the coast, — 60°. Thus the influence of the Gulf Stream, which prevents the fiords from freezing over, does not penetrate inland. The fall of snow in winter is not very large at Bossekop, but also increases towards the interior. In very cold weather the snow does not come down in flakes, but takes the form of crystals of ice, which, having no cohesion, are blown about by every puff of wind.

The Lapps may be divided into two classes, — the very poor fishermen of the coast and the nomadic Lapps of the mountains, who often possess considerable property. Of late years a third class has sprung up, which has settled in two inland places, Karasjok and Kautokeino. At the beginning of March the Lapps gather to a great fair at Bossekop, where many thousand ptarmigan, several tons of reindeer flesh, besides butter and tongues, change hands. Herr Baschin drove to Karasjok in a reindeer sledge, a vehicle that requires a deal of management, in order to inspect the dwellings of the Lapps settled there. The village is situated on a stream of the same name, one of the headwaters of the Tana, the second largest river of Norway, and contains about 200 inhabitants — all, with few exceptions, Lapps. Their dwellings are conical tents, 13 to 16 feet in diameter, with openings at the top to let out the smoke from the fire in the centre. Many Lapps own 2,000 to 3,000 head of reindeer. These people are not so powerful, intelligent, and honest as the Eskimo, and give the Norwegian Government much trouble through their propensity to steal reindeer. In Karasjok Herr Baschin found Balto and Ravna, the two Lapps who accompanied Dr. Nansen on his journey across Greenland, and on his voyage home he inspected that explorer's new vessel, which is being built at Laurvig. It has a nearly semi-circular cross-section, and is rigged as a three-masted schooner. It is of 250 tons register, and is constructed almost entirely of German oak. A small engine will enable it to make six knots an hour during calms.

[1] From the Scottish Geographical Magazine.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Laboratory Teaching.

IN a recent number of *Science* there appeared an excellent article by Professor Chas. F. Mabery upon "Aims of Laboratory Teaching," in which occurred the following sentence: "Probably the earliest attempt in this country to give systematic laboratory instruction, to classes of any magnitude, was made in 1865 at the Massachusetts Institute of Technology."

Professor Mabery is surely in error upon this point, as such instruction had been given the students of the Rensselaer Polytechnic Instituie for many years previous to the date quoted. Our present laboratory, which is very complete and accommodates seventy-six students at a time in analytical chemistry, was built in 1862, to replace the one destroyed by fire in that year. Permit me to quote from a letter just received from Professor James Hall, geologist of the State of New York, who graduated from this institution many years ago: "In regard to systematic laboratory instruction in chemistry, I can only say that when I entered the Rensselaer School in 1831 there were already laboratories fitted up for giving systematic instruction in chemistry, and each student of the class

was required to do laboratory work, and to prepare himself his material and apparatus, to give each day during the course an extemporaneous lecture, illustrated by experiments, and full explanation of the phenomena and the laws governing them. Every student was well grounded in the principles and elements of the science, and by a method of teaching never surpassed, if ever equalled, by any other." WILLIAM P. MASON.

Troy, N.Y., July 29.

AMONG THE PUBLISHERS.

THE ninth annual issue of "The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland" has recently been issued by Charles Griffin & Co., Exeter Street, Strand, London. The present issue gives a well-edited chronicle of the work done during the past year by the learned societies of Great Britain and Ireland, together with lists of the officers and a brief statement of the history and purposes of the organizations. The lists of the papers are quite complete, most of the society secretaries having given the needed information, and make a showing of scientific and literary activity with which we have as yet but little to compare in America. The hand-book is well made for its purpose, and would prove an excellent book of reference in American libraries.

— A vigorous statement of the scientific principles upon which the treatment of criminals should be based will open *The Popular Science Monthly* for August. It is by Professor Edward S. Morse, who takes as his title "Natural Selection and Crime." The Warfare of Science papers, by Dr. Andrew D. White, will be continued with a chapter on "Geography," in which are given the various mythological and theological ideas concerning the form of the earth and the proper mode of representing it that have prevailed in ancient and mediæval times. "The Manufacture of Boots and Shoes" will be described by George A. Rich. This is one of the illustrated series of Articles on American Industries, and, in both the text and the pictures, tells a story of wonderful progress. An ethical study on "Veracity," by Herbert Spencer, will be among the contents.

— The Geographical Society of Germany will shortly publish a volume commemorative of the four-hundredth anniversary of the discovery of America by Columbus, which will, it is said, be one of the most elaborate publications ever issued by the society. Dr. Konrad Kretschmer, the editor of the forthcoming work, has visited all the principal libraries of Italy in search of material, and has had access to many rare manuscripts hitherto unused. The memorial volume will contain forty five maps relating to the discovery of America, thirty-one of which are said to have never been published. Emperor William has contributed 15,000 marks

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Taxidermist going out of business has quantity of finely-mounted specimens of North American birds, mammals and reptiles and skins of birds for sale, including a full local collection of bird skins, showing some great variations of species; also quantity of skulls with horns of deer and mountain sheep, and mounted heads of same. Will give good exchange for Hawk Eye camera with outfit. Apply quickly to J. R. Thurston, 265 Yonge St., Toronto, Canada.

For exchange.—A fine thirteen-keyed flute in leather covered case, for a photograph camera suitable for making lantern slides. Flute cost $27, and is nearly new. U. O. COX, Mankato, Minn.

To exchange; Experiment Station bulletins and reports for bulletins and reports not in my file. I will send list of what I have for exchange. P. H. ROLFS, Lake City, Florida.

Finished specimens of all colors of Vermont marble for fine fossils or crystals. Will be given only for valuable specimens because of the cost of polishing. GEO. W. PERRY, State Geologist, Rutland, Vt.

For exchange.—Three copies of "American State Papers Bearing on Sunday Legislation," 1891, $2.50, new and unused, for "The Sabbath," by Harmon Kingsbury, 1840; "The Sabbath," by A. A. Phelps, 1842; "History of the Institution of the Sabbath Day, Its Uses and Abuses," by W. L. Fisher, 1859; "Humorous Phases of the Law," by Irving Browne; or other works amounting to value of books exchanged, on the question of governmental legislation in reference to religion. personal liberty, etc. If preferred, I will sell "American State Papers," and buy other books on the subject. WILLIAM ADDISON BLAKELY, Chicago, Ill.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g. to 1-10mg.), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862–1885 (62–71 bound); Smithsonian Reports, 1854–1883; U. S. Coast Survey, 1854–1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

Wanted, in exchange for the following works, any standard works on Surgery and on Diseases of Children: Wilson's "American Ornithology," 3 vols.; Coues' "Birds of the Northwest" and "Birds of the Colorado Valley," 2 vols.; Minot's "Land and Game Birds of New England;" Samuels' "Our Northern and Eastern Birds;" all the Reports on the Birds of the Pacific R. R. Survey, bound in 2 vols., morocco; and a complete set of the Reports of the Arkansas Geological Survey. Please give editions and dates in corresponding. R. ELLSWORTH CALL, High School, Des Moines, Iowa.

To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

WANTED.—A collection of postage stamps; one made previous to 1870 preferred. Also old and curious stamps on original letters, and old entire U S. stamped envelopes. Will pay cash or give in exchange first-class fossils, including fine crinoids. WM. F. E. GURLEY, Danville, Ill.

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WANTED.—The services of a wide-awake young man, as correspondent, in a large manufacturing optical business; one preferred who has a thorough knowledge of microscopy and some knowledge of photography. Address by letter, stating age and references. Optical, care of Science, 874 Broadway, New York.

WANTED.—We want any and all of the following, providing we can trade other books and magazines or buy them cheap for cash: Academy, London, vol. 1 to 28, 35, Jan. and Feb., '89; Age of Steel, vol. 1 to 66; American Antiquarian, vol. 1, 2; American Architect, vol. 1 to 6, 9; American Art Review. vol. 3; American Field, vol. 1 to 21; American Geologist, vol. 1 to 6; American Machinist, vol. 1 to 4; Art Amateur, vol. 1 to 7, Oct., '4; Art Interchange, vol 1 to 9; Art Union, vol. 1 to 4, Jan., '44, July, '45; Bibliotheca Sacra, vol 1 to 46; Godey's Lady's Book, vol. 1 to 20; New Englander, vol. 11; Zoologist, Series 1 and 1, Series 3 vol. 1 to 14; Allen Armendale (a novel). Raymer's "Old Book" Store, 243 4th Ave. S., Minneapolis, Minn.

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WANTED.—To act as correspondent for one or two daily or weekly papers. Have worked on paper for about two years Would like a position on editorial staff of humorous paper. Address GEO. C. MASON, 14 Elm St., Hartford, Conn.

TRANSLATOR wanted to read German architectural works at sight (no writing). One familiar with technical terms desired. Address "A.," Box 149, New York Post Office.

towards the expenses of publication, etc., and the work will undoubtedly be a most valuable contribution to the early history of America. It is expected that it will leave the government printing office early in August.

— In a capital address on "tooth culture," delivered at the annual meeting of the Eastern Counties Branch of the British Dental Association, and printed in *Lancet*, Sir James Crichton-Browne referred to a change which has taken place in bread, as one of the causes of the increase of dental caries. So far as England is concerned, this is essentially an age of white bread and fine flour, and it is an age therefore in which we are no longer partaking, to anything like the same amount that our ancestors did, of the bran or husky parts of wheat, and so are deprived to a large degree of a chemical element which they contain — namely, fluorine. The late Dr. George Wilson showed that fluorine is more widely distributed in nature than was before his time supposed, but still, as he pointed out, it is but sparingly present where it does occur, and the only channels by which it can apparently find its way into the animal economy are through the siliceous stems of grasses and the outer husks of grain, in which it exists in comparative abundance. Analysis has proved that the enamel of the teeth contains more fluorine, in the form of fluoride of calcium, than any other part of the body, and fluorine might, indeed, be regarded as the characteristic chemical constituent of this structure, the hardest of all animal tissue, and containing 95 5 per cent of salts, against 72 per cent in the dentine. As this is so, it is clear that a supply of fluorine, while the development of the teeth is proceeding, is essential to the proper formation of the enamel, and that any deficiency in this respect must result in thin and inferior enamel. Sir James Crichton-Browne thinks it well worthy of consideration whether the reintroduction into our diet of a supply of fluorine in some suitable natural form — and what form, he asks, can be more suitable than that in which it exists in the pellicles of our grain stuffs? — might not do something to fortify the teeth of the next generation.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
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Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
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Iowa Academy of Sciences.
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Jassidæ; Notes on Local.
Keller, Helen.
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Some of the Contributors to *Science* Since Jan. 1, 1892.

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SCIENCE

NEW YORK, JULY 29, 1892.

RICE CULTURE IN JAPAN, MEXICO, AND THE UNITED STATES FROM THE HYGIENIC POINT OF VIEW.[1]

BY ALBERT S. ASHMEAD, M.D.

ONE of the most important problems to be solved by the Japanese medical profession is the application of a rational and efficient hygiene to the culture of rice. This culture lies, so to speak, at the very foundation of Japanese life. When the rice crop is abundant Japan is well fed, healthy, and content; when it fails, Japan droops and starves. Japan almost lives on rice, and, consequently, a considerable part of its population in employed in the culture of rice. This large fraction of the people, at least, is exposed to all the dangers which arise from a careless, imprudent, or slovenly system of cultivation, and the dangers, as every one knows, are very great, and, as every one knows, also, little is done in Japan to obviate them.

Rice culture is a watery business. Almost the whole population of Japan forms around its island a fringe, fifteen miles deep, leaving the interior a comparative desert. This fringe is exceedingly populous. From one town to the other you find scattered along the roads innumerable houses, so that it is impossible for a stranger to say where one village begins and the other ends; they dovetail into one another, as it were. In the interior the rare population is concerned with silk, lacquer, pottery, etc.; but in this fringe there is scarcely anything but rice culture. The sea washes, penetrates, at times partly covers by its tides, the coast-land, and furnishes the constant dampness necessary for the growth of rice. The sea takes away multitudinous parcels of the rice coast by forming swamps; and sometimes seems to be intent on compensation by giving something of its own; thus, for instance, a portion of the city of Tokio, now inhabited by 120,000 people, and which 200 years ago was under water, may be considered as a gift of the ocean.

The traveller in Japan is forcibly reminded of the cities of Egypt, perched upon their elevated seats during the overflow of their grand river. Here the inundation is an artificial one; the waters of the innumerable swamps formed, either by the sea or by the rivers, have been directed into the rice fields all around the villages, and the latter appear like islands. Even when the time of the flooding is ended, shallow marshes remain everywhere, for the drainage is imperfect, to say the least. The stork, the king of the swamps, is the national bird of Japan, semi-sacred, and, in olden times, Mikados and Tycoons alone were allowed to eat of it.

We must also, in an article on rice culture in Japan, take into account the exuberant canal system of that country. The traffic of the country is almost all on the canals, which join one river to the other, and form a network of filthy water over the whole extent of the densely populated zone. I said of filthy water, for it contains all the surface drainage of the large cities. Garbage[2] is continually, or rather systematically, thrown into the deep, elaborately built, stone gutters in which there is a perpetual flow of water, so that even a regular eel fishery goes on in them. These gutters do the work of our scavengers, without any cost to the city; they carry the city filth into the canals, and from the canals not only to the sea but also into the rice fields. A river is nowhere allowed to pass without paying toll in the form of public service; it enters into the sea only after it has washed the cities which it met in its course. On its surface it carries still more filth, if possible, than in its waters, for the contents of all the public closets, in the streets and in the houses, are daily carted to some boats and brought to the rice fields, to serve as manure. There, at the rice field, the liquid manure is preserved in tanks until the proper time has come for using it, after the drainage of the plantation, when the farmer feeds the growing plant by pouring over its roots with a dipper. The solid part is applied to the soil before the planting.

From all this it appears that the culture of rice in Japan is naturally a thorn in the side of the medical profession.

The first evil resulting from this occupation in Japan is impaludism, which is exceedingly frequent in all the rice plains until the monsoons of the spring and the autumn sweep away most of the paludic emanations.

Typhoid fever and its complications, together with other pernicious types, and the diseases caused by the distoma are due to the infection of drinking water by their deleterious system of manuring and draining.

It has occurred to several leprologists that there may be a connection between lepra and impaludism. It is a fact that the more malarious the situation of a sea-coast the greater is the number of lepers there. Moreover, it may be considered as a significant fact, that the first outbreak of leprosy is, in a large number of cases, in China as well as in Japan, preceded by one or several attacks of paludic fevers. It has even been suggested that the origin of leprosy might be in the malarious mud through which the rice laborers are continually wading. So much for Japan.

The situation in Mexico, a country allied with Japan in many ways, in climate, in constitution of inhabitants, irrigation system, etc., is aptly described by Dr. Nazario Lomas, member of the Board of Health of the State of Morelos, Director of the General Hospital, Cuernavaca (Morelos), Mexico. His paper on the subject was read in Kansas City (United States) before the American Public Health Association, Oct., 1891. I give here the essential part of it: "During the last five years the cultivation of rice by irrigation has become one of the chief elements of the prosperity of this State (Morelos, Mexico). In course of these five years we have seen the plantations increasing rapidly, while a corresponding deterioration was observed in the salubrity of neighboring towns. And how could it be otherwise, seeing that the rice swamps are exposed to a mean temperature of 33 degrees centigrade in summer and 28 degrees in winter?

"I think I need not here enter into any details about the cultivation of rice; in a general way, quite sufficient for my purpose, every one is acquainted with this subject. Let me only remind the reader that there are two systems of cultivation: dry (on hills), and by irrigation. The latter has two sub-divisions, irrigation by current and irrigation by flooding.

[1] Communicated to the Sei-I-Kwai, or Society for the Advancement of Medical Science in Japan.

[2] However it must not be forgotten that garbage in Japan is of a more simple and less lurid kind than ours; it consists chiefly of the refuse of fish and vegetable diet; no meat bones, no stale bread or other characteristics of our own garbage.

"The sytem of irrigation by flood, which, happily, we do not know as yet in the State of Morelos, but which is likely enough to be introduced by and by, as the rice culture progresses, is the worst of all. It is this system especially that is meant when competent authorities denounce the cultivation of rice as homicidal, declare its history to be one of blood, and contend that every sixteen hectolitres of rice are bought at the price of one man's life. This form of irrigation is said by experienced men to combine in the most effective manner all the evils of the very worst of sweet-water swamps.

"The rice cultivated under the current system, now generally adopted in this State, is irrigated from February to September by means of currents, renewed according to the necessities of the plant, but generally continuous. Now as perfect slopes are rare, the drainage is rarely, if ever, complete, so that every field of any considerable extent presents hollows ready to receive swamps. Moreover, the want of canals and drains, or their imperfection, is cause that at the points of entrance and exit the irrigation water diffuses itself in lagoons. But supposing even this system to be carried out in the most perfect manner, without any flaw, there remains still the evaporation, on an immense surface, from a soil exceedingly rich in organic matter. The harvest begins in September. It leaves on the ground, more or less damp and swampy, a large quantity of vegetable detritus, whose decomposition fills the air with most pernicious, because ever renewed, poison.

"As to the dry system, which is used on hill-sides, I am not practically acquainted with it. Of course it is not as unhealthy as the two others, but then it is less productive.

"Now, if once we have created in our midst this class of artificial morasses, with a large superficial extension, we find safely established among us the paludic fevers and all classes of gastro-intestinal affections. These are always endemic in the districts where rice is cultivated.

"Each progress of the rice culture is followed by a correspondent advantage gained by the fever. More than fifty per cent of the field-hands are attacked by it. It appears under all its forms, but mostly under those of daily intermittent, tertiary, and continuous fever; in the first two cases it is accompanied almost at the onset with swelling and hardness of the spleen, and very frequently of the liver. It is to be observed that the continuous or remittent fevers do not at once appear as such, they are usually preceded by two or three attacks of daily intermittent fever, whose duration gradually increases until the disease becomes continuous or remittent. Notwithstanding its paludic nature, this fever is not amenable to any form of quinine. Neuralgia, especially in the form of trigeminus, urticaria, and purple spots, is very frequent. Pneumonia becomes here an epidemic, and is cured, or very favorably influenced, by the use of salts of quinine: this observation is continually made in the battalions which come from the south. The day-laborers who come down from the central table-land and the Valley of Mexico are almost invariably affected with cachexia on their arrival.

"I think this is the place to give a few details concerning the physical geography of the State of Morelos. It forms an inclined plane from north to south. Its highest parts are 2,000 metres, and the lowest 500 to 650 metres above the level of the sea. The prevailing winds by day are from south to north, by night from north to south.

"There is an abundance of water, both from springs and rivers; the former is sweet, the latter sweet and salt.

"The course of the waters is naturally opposed to the formation of lagoons or swamps, and the climate must have been very healthy in former times.

"It is in the lower part of the State that the rice is cultivated. It grows there in company with the sugar-cane, another cause of paludism.

"The hygienic measures which the State Board of Health submitted to the approbation of the government, through my initiative, are as follows: —

"1. The cultivation of rice by the flooding system is, in no case, to be allowed, even as a trial.

"2. No new rice plantation shall be established, without a license from the government, for the granting of which, the Board of Health is to be consulted, the State engineer to be a member of such Board. The Board will appoint a committee to study the subject, composed of one of its members residing in Cuernavaca, a physician from the rice districts, who may be a corresponding member of the Board, and of the State engineer.

"3. If the ground, in which it is proposed to cultivate rice, is situated to the south or north of any village or town, and distant therefrom less than 3,000 metres, the petition shall be at once rejected, unless, in the opinion of the health experts, not less than three in number, the three being unanimous, an intervening hill, or forest, or other such natural feature, removes the danger.

"4. Any rice-planter who shall commence his harvest with the ground in a soaked condition, if such condition is due to bad management or carelessness, the waters not having been removed in due season, shall be liable to a fine of not less than $50, the amount to be fixed in consultation with the governor, and to be deposited with the funds of the State.

"5. The cultivation shall be suspended on any plantation, in which, in the opinion of the engineer of the Board, the irrigation waters form swamps or lagoons, either at the entrance or at the outlet. Once these defects removed, the permission to cultivate may be renewed.

"6. Any person may denounce before the Board, or its correspondents in the district, any defects in the irrigation or cultivation, which may cause the formation of swamps.

"7. Whenever the rice is beaten down by strong winds, hail-storms, etc., it must at once be cut, and especially if it is in the water.

"8. The laborers employed in the rice culture will begin work after sunrise, and will leave the fields before sunset.

"9. The overseers will, under no circumstances, allow the wives of the laborers to bring them their meals or visit them in the fields. This prohibition applies with still better reason to children.

"10. The owners and administrators of rice plantations, who have the well-being of their laborers at heart, may apply to the State Board of Health and obtain from it a pamphlet setting forth the rules to be observed for the prevention and cure of paludic fever."

There is a large rice culture in the United States also. How large is shown by the following numbers, which I have obtained from the U. S. Department of Agriculture. In 1879 the census data for the crop were as follows: —

	Pounds.
South Carolina	**52,077,515**
Georgia	**25,369,687**
Louisiana	**23,188,311**
All other States	**9,495,860**
Total	**110,131,373**

Estimates by State Commissioners of Agriculture are available for recent years for South Carolina and Louisiana. The figures of production for the last three years at hand are:—

	South Carolina.	Louisiana.
1888	67,752,374	51,414,909
1889	93,143,508	63,330,897
1890	68,091,944	

The production for Louisiana for 1890 is given at about 1,000,000 barrels of rough rice.

The largest cultivator of rice in the United States is probably Col. John Screven of Savannah, Ga. It is to the kindness of this gentleman that I am indebted for the following information, relating to the rice culture in Georgia and the Carolinas (I leave Louisiana entirely out because the situation there is complicated by the presence of the sugar-cane culture).

"There are only two systems: tide-water, and inland or back-water culture. In the latter system, the water is derived from swamp or still-water reservoirs, formed by banking in the water of swamps and so retaining it convenient for the irrigation of adjacent fields. The culture of such fields is practically the same as in tide-water culture, the water being applied and removed at pleasure, provided the reservoirs or back-waters are sufficiently supplied, as may not be the case in seasons of drought. In the former, or tide-water system, a want of water-supply can scarcely occur, certainly not at the periods of spring tides, on which the system of irrigation is commonly based.

"The tidal lands lie in the deltas of the rivers and in their natural state are subject to overflow, certainly in the spring-tides, and being extremely level may be covered by 'great tides'[1] to a depth to hide summits. As these lands contract and settle under drainage and cultivation, this advantage is increased after they are taken in.

"They are embanked sufficiently to keep out the highest tides, and water gates, called "trunks," are laid, so as to admit or discharge the water, as the tides rise or fall. At these gates the drainage fall is from four to five feet in the Savannah River, where the mean tide-fall is about six and a half feet. The average drainage of the fields, however, will not exceed three and a half feet. To make the drainage as complete as possible, main ditches, say six feet wide by four feet deep, are dug around the fields, which are again subdivided by minor ditches, 2 feet wide by three feet deep, called quarter drains, cut parallel about seventy-five feet apart. This ditch system is not all-important for irrigation. It combines greater value in the rapid and thorough drainage it affords; for rice is an amphibious plant, and while irrigation is very necessary to its successful growth, good drainage, the more rapid the better, is equally necessary, for reasons which need not be stated here, as we have to consider only its hygienic value."

I had addressed to Col. Screven a number of questions relating to this subject. I give them here with the answers I received.

1. Which is the least dangerous of the different systems of irrigation? Answer. The tide-water system, because the water is not taken from stagnant reservoirs, and may be oftener changed.

2. What is the system of manuring generally adopted, are human excrements used? Answer. Commercial fertilizers are more commonly used — human excrements *never*.

[1] This is the almanac term for the high spring tides raised by the union of new or full and perigee moon — not storm-tides.

3. What means are used to prevent the contamination of drinking water? Answer. Water from wells, sometimes artesian, is used, very commonly water drawn directly from the river, which, by the more careful, is cleared by settling, or is filtered.

4. What seasons are most unwholesome for the cultivators? Answer. The summer and ante-frost autumnal months, commencing with July and the harvest flow, and especially after that flow is removed, say, from August 15, when it is cast off for the harvest, and the water-growth, animal, and vegetal exposed to the sun and decay.

5. Do the hands live in the immediate neighborhood of the plantations or, perhaps, on higher ground? Answer. Either, as convenience dictates, or on the plantation itself. Very often higher grounds are more unwholesome than the level of the rice-fields. Settlements close to the river-shore, where the tides move the atmosphere, and the winds are least impeded, are often the most healthy. High grounds overlooking rice-fields, and not well-shielded from them by vegetation, are considered most unwholesome. It should be stated that the cultivators (laborers) in the rice-fields are negroes, who are constitutionally less liable to fevers than whites. Ordinarily, the white residents of rice-fields abandon them from May 1 until frost the following autumn.

6. What system is used to dry the ground? Answer. The drainage method already described. The rice-fields are never pondy or muddy when properly drained. During the dry stages, they admit the plow, harrow, toothed roller, drill, or any other appropriate agricultural implement, and are sometimes even dusty, when stirred.

7. What is done to prevent the formation of swamps or lagoons? Answer. Effective drainage.

8. Is anything done to prevent infection from the rotting crops which have been beaten down by storms? Answer. When drainage is effective, serious infection is not likely to occur from crops beaten down by storms.

9. Are laborers permitted to work in the rice-fields before sunrise and after sunset? Answer. The most dangerous time to laborers is in the harvest, when the hot suns raise noxious effluvia in the fields from decaying water vegetation and animalculæ. At such times the laborers (negroes) seek their work in the early morning before sunrise, so as to complete their tasks before afternoon, when the sun is most oppressive. They fear the sun more than malaria.

10. What means are taken to obviate malarial and typhoid fevers? Answer. None specially; incidentally such drainage as is necessary to successful rice culture Drainage and good health are as interdependent as drainage and good husbandry. *As for typhoid fever, it is unknown in the rice-fields, even among whites.* Filth diseases are rare. If by "malarial fevers" is meant fevers other than those from paludal (marsh) causes, I venture to assert that in the rice-fields, and on the southern Atlantic coast generally, there is marked absence of them, and where fevers prevail from paludal (marsh) causes (bilious fevers?) typhoid fever will not originate. It is a notable fact, that typhoid fever was unknown in the city of Savannah before 1861.

In conclusion, I will in a few words give such advice to Japanese sanitarians as is clearly suggested by the preceding facts. 1. First of all, there is one thing that must be done if the culture is not to remain what it is now, a public calamity; the immunditæ must be kept out of the water. I should advocate the use of artificial manures, — bone phosphates and American fertilizers. Thus the general infection of drinking water with typhoid, cholera, and other germs, would cease.

2. It would be worth while, perhaps, if a trial was made to obtain negro labor for the rice plantations. The negro is proof against malarious influences in a considerable measure. Might not colored laborers be imported from Georgia and the Carolinas?

CURRENT NOTES ON ANTHROPOLOGY. — XI.

[*Edited by D. G. Brinton, M.D., LL.D.*]

Canadian Archæology.

UNDER the efficient superintendence of Mr. David Boyle, curator, the archæological collection of the Canadian Institute, Toronto, has grown to be the largest in existence, illustrating the prehistoric condition of man in the province of Ontario. His excellent reports, which have appeared annually since 1887, describe with great accuracy and sufficient fullness the yearly accessions to the collection of antiquities.

Objects which can properly be called palæolithic have not yet been found in Canada. This is the opinion of Mr. Boyle as expressed in his last report. Of course, forms simulating those of the old stone age occur, but this is not conclusive. Stone is the principal material, and in its shaping and dressing the Canadian Indians were not behind their neighbors to the south. The collection also contains many specimens of their pottery. It is well burned, ornamented with designs in scroll and line, and some of the vases are "almost classic in outline." The pipes, both stone and clay, are a prominent feature in the reports, and evidently were the objects of solicitous workmanship. Copper specimens are by no means unusual, some being knives, others spear-heads, with planges and sockets, others ornaments, as beads, bracelets, etc. Examples in bone, shell, and horn are also figured. About a hundred of the crania unearthed have been examined. They indicate a people with moderately dolichocephalic skulls, averaging a cranial index of 74.5.

It is to be hoped that the government of the Dominion will continue to lend assistance to this creditable effort to illustrate the archæology of Ontario.

The Question of the Basques.

As some readers of *Science* have manifested an interest in the Basques, they will doubtless be pleased to learn that at the next meeting of the French Association for the Advancement of Science, to be held at Pau, from the 15th to the 22d of September next, the Anthropological Section intends to devote most of its energies to settling "La Question Basque." According to an announcement of the President of the Section, Dr. Magitot, the question is to be attacked on all four sides: first, the history and origin of the Euskarian people; next, their anthropological characters; third, their language; and finally, their traditions and folk-lore. From such an onset as this we may hope for some positive results.

Not much can be expected from a study of the language. There is probably no other living idiom which has had its vocabulary so completely foreignized as the Basque. At the Congrés Scientifique International des Catholiques last year, the Comte de Charency, who is a good authority on the tongue, stated that at least nine-tenths of its words were borrowed from the Latin and Romance languages, and then proceeded to point out that a considerable percentage of the remainder were Celtic, Greek, or Germanic in origin. There is almost nothing left of the original Euskarian but its grammar; and this, it may be added in passing, shows no relationship to that of either Ural-Altaic or American tongues, in spite of various statements to the contrary.

On Left-Handedness.

Why are most people right-handed? Why are a few left-handed? These are questions which have puzzled all physiologists who have attempted their solution. The various theories put forward are compactly presented by Sir Daniel Wilson in his recent work, "The Right Hand: Left-Handedness" (London, 1891). His final conclusion is that left-handedness is due to "an exceptional development of the right hemisphere of the brain." But it must be acknowledged that his evidence, consisting of a single autopsy, is far from sufficient.

Sir Daniel calls attention to the fact that the forms of some ancient stone implements prove that palæolithic man was sometimes left-handed, and distinctly was not ambidextrous, as some have maintained. He does not refer to De Mortillet's tables in the Bull. Soc. D'Anthopologie, 1890, which show that at that time in France the men averaged more than twice as many left-handed individuals as at present; and at certain localities, as at Chassey, on the upper Rhone, the left-handed were in the large majority.

In Sir Daniel's generally very thorough volume there are but few references to this phenomenon in the lower animals, and no mention of its occurrence in snails. It may, indeed, sound like a "bull," to talk of animals as left-handed who have no hands, but the physiological phenomenon is plainly present. It is shown in the direction in which they construct the spiral of their shell. With the ordinary vine snail this is from left to right; but once in about 3,000 times it is from right to left. They are then known as *sinistrorsa*. In the genus *Partula* far more frequent examples occur, and indeed species have been named from this peculiarity. Whatever its cause, in mollusk and in man the same law is operative.

The Mentone Cave-Burials.

Near Mentone, but on the Italian side of the frontier, there are several caves in the cretaceous sea-cliffs, whose contents have long attracted the lively attention of archæologists. Unluckily, they have been worked over so much that the original stratification is no longer apparent; but throughout the mass, flint chips and rude bone implements have been abundantly found, of such a character that they have been unanimously referred to palæolithic man, to that period of his existence in western Europe which De Mortillet has called Solutreen.

Thus far, all is harmony; but in this deposit, at various depths, skeletons have been unearthed, and a lively discussion ensued as to whether these should be considered also of palæolithic time, or of later date. This debate has been renewed by fresh discoveries of such remains in February last, a good description of which, by Mr. A Vaughan Jennings, appears in *Natural Science* for June. They are said to be of unusual size, relics of men from six and a half to seven feet tall; but it is well known how easily one is deceived in measuring skeletons. With them were worked ornaments of bone and shell, necklaces, and finely-chipped arrowheads. These indications point conclusively to the fact of deliberate interment at a period when mortuary ceremonies were definite and solemn rites, and unquestionably, therefore, to neolithic times. In spite of the depth at which they were found, perhaps twenty-five feet below the modern level of the cave floor, they must be accepted as endorsing De Mortillet's rejection of the human remains as palæolithic.

Ethnology as Philosophy.

Among the most thoughtful writers on the meaning and mission of ethnology must be named Dr. A. H. Post of

Bremen. He is the author of several important works, and an essay of his, on "Ethnological Jurisprudence," was translated and published last year in the *Monist*, at Chicago.

In a recent number of the *Globus* he publishes some "Ethnological Reflections," which are intended to set forth the true position of ethnology with reference to other sciences. He defines ethnology as "the natural history of social life," and he believes that the time will come when all the so-called "social sciences" will be taught as its branches. He points out with force that this will bring about a revolution in all traditional methods of education, for there is a fundamental and irreconcilable antagonism between the two methods. Natural science denies absolutely the free will of man, the validity of *a priori* reasoning on any subject, the possibility of a "categorical imperative" in ethics, the abstract truth of any doctrine of religion or morals, the supremacy of any individual. All is an endless and unavoidable chain of cause and effect.

It appears to me that such a view of ethnology is true so far as it relates to the growth of societies under natural surroundings. The social unit is cribbed and confined by iron laws, and its development is in a measure subject to these; but in a measure only. It is even less true of the individual. For to deny free-will to man not only leads at once into logical contradictions of the grossest kind, but is contrary to the soundest maxims of inductive philosophy. As John Stuart Mill, whom no one will accuse of prejudice, pointed out, we are certain of nothing so surely as of our own feelings, and of these the strongest is that of our own individuality, and of it as a free agent.

Dr. Post has here committed the same error as another distinguished ethnologist, lately mentioned in these columns (*Science*, June 3), that of seeking to make ethnology synthetic, when its study should be objective and analytic. Where it leads him, his article curiously shows. On one page he says that to the ethnologist no social condition is good or bad, but merely present as a subject for study; and on the very next page he falls to bewailing the egotistic strife in modern society as threatening the ruin of the social edifice!

NOTES AND NEWS.

THE next meeting the American Association for the Advancement of Science, to be held in Rochester, N.Y., Aug. 17–24, will be of unusual interest and importance, especially to the members of the Section of Biology. At this meeting will be considered the place of meeting for 1893, and consequently the attitude of the association toward the Columbian Exposition. But even of greater importance to biologists will be the consideration and probably the decision of the question of the division of the section into two, — one for the botanists, and one for the zoologists. It is hoped, also, that there will come up for discussion the report of the American Branch of the International Committee on Biological Nomenclature. This report has nothing to do with the naming of species, but will consider the terminology to be employed in anatomy, embryology, etc. In view of the matters of general interest to the whole association, and those of vital interest to Section F, it is expected that there will be a large attendance of botanists and zoologists and a long list of papers to be presented before the present section of biology.

— Bulletin No. 23 of the West Virginia Agricultural Experiment Station, entitled "Illustrated Descriptive List of Weeds," contains a considerable amount of information in a condensed form. It is written by Dr. C. F. Millspaugh, botanist of the station. Illustrations of all the important families, as well as of a number of species, enable one unfamiliar with the weeds to recognize them. Short descriptions are given of each, with mention of any special medicinal value they may possess as household remedies. Some two hundred species are mentioned. One might reasonably question the justice of considering the locust (*Robinia pseudacacia*), the honey locust (*Gleditschia triacanthos*), or the wild hydrangea (*Hydrangea arborescens*) as weeds. The list would naturally not be the same for all States, but it is a little surprising not to find *Potentilla norvegica* mentioned. In south-western Ohio, and doubtless other localities, whole fields have been overrun by this plant, and it is much worse in this respect than *P. canadensis*, which is mentioned in the Bulletin. A number of typographical errors show carelessness in proof-reading.

— At a meeting of the Paris Geographical Society on May 20, according to *The Scottish Geographical Magazine*, M. Venukoff gave a sketch of the surveys executed in Russia during the year 1891. After referring to the exploration of the Black Sea continued by MM. Spindler, Andrussof, and Wrangell, of which an account was given on page 154 of this volume, he turned to the geodetic and topographical work executed in the Crimea, which has been the means of ascertaining that the Roman Kosh (5,601 feet high) is the culminating point of the mountains of the peninsula, and not the Tchatyr Dagh (5,002 feet), as has hitherto been supposed. The phenomena of terrestrial magnetism and the local attractions of the mountains of the Crimea have also received attention. Among the geodetic works produced is a large map of the triangulation between Kishineff and Astrakhan, along the parallel of 47° 30′ N. This arc extends over nineteen degrees of longitude. It is remarkable that this triangulation, though quite independent, agrees exactly with that of the 52d parallel in regard to the anomalies observed in the length of different degrees of longitude (see vol. vii., p. 494). Between the same meridians the differences of the lengths of degrees of longitude, as measured geodetically and calculated astronomically, have always the same sign.

— For several years the chemical division of the U. S. Department of Agriculture, under H. W. Wiley, has been giving considerable attention to the subject of adulterants, and in part seventh of bulletin No. 13 is reported a series of investigations made on the adulterations of tea, coffee, and cocoa preparations. The conclusion reached is that teas are not now adulterated to so great an extent as formerly, and that the adulterants used are, as a rule, not such as may be considered prejudicial to health. In the case of coffee the use of adulterants seems to be on the increase. Of the samples of ground coffee examined, 90 per cent were found to be adulterated in some way, some of them containing no coffee whatever. Chicory is largely used as an adulterant of coffee, as well as wheat, rye, corn, peas, acorns, molasses, etc. Not only is ground coffee adulterated, but numerous imitations of unground coffee are on the market, a few imitating green coffee, but the larger number intended to be mixed with roasted coffees. The following description of some of them is taken from the bulletin: "8,951. Coffee pellets, molded, but not in the form of coffee beans. When mixed with ground coffee would escape the notice of the purchaser, also probably in mixture with whole coffee. Composition; wheat flour and bran, rye also probably present. Manufactured by the Clark Coffee Company, office 156 State Street, Boston; factory, Roxbury, Mass. Price, 6 cents per pound, or 5½ cents in 10-barrel lots. The manufacturers claim that an addition of 33 per cent of these 'pellets' to genuine coffee will make 'an equal drink to the straight goods.' The manufacturers, after making extravagant claims for their product, state, with evident intention to further a fraud, that 'it is uniform in color, and can be furnished with any desired color of roast.' 8,955. Imitation coffee beans. Composed of wheat flour, light roast. Manufactured by the Swedish Coffee Company, New York. 8,956. Similar to 8,955, and of the same manufacture. Composition; wheat flour and probably saw-dust. Dark roast; two kinds of berries. 8,957. Imitation coffee beans. Composition; wheat flour. Manufactured by L. H. Hall, 1,017 Chestnut Street, Philadelphia, Pa." Another method of sophisticating coffee is to treat it for the manufacture of coffee extract, after which the grains are roasted a second time, with the addition of a little sugar to cover the berries with a deceptive glazing.

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MODERN BOTANY.[1]

BY CHARLES R. BARNES, PROFESSOR OF BOTANY IN THE UNIVERSITY OF WISCONSIN.

I VENTURE to say that the ideas conjured up by the words "botany" and "botanists" in the minds of those of you whose school days ceased anywhere from fifteen to twenty years ago, or perhaps even at a later date, will be one which is very widely different from the ideas that those words ought to bring up. To most people the word "botany" recalls something which chiefly means the collecting of flowering plants in the spring; pulling flowers to pieces in an endeavor, too often a vain endeavor, to find out a long, hard name for the plant; an endeavor which is often vain unless they have acquired the very useful trick of looking in the index for the common name. The word "botanist" brings to mind a sort of harmless crank who spends most of his time in wandering about fields and woods and poking into swamps and bringing home arms full or boxes full of plants; perchance drying them and preserving them. Yet these two ideas are so extremely foreign to the subject of botany as it is thought of to-day, that I venture to present to you some hints of what modern botany is, and particularly what modern botany is on its economic side. The study that I have indicated as being the common one is the study of a part only of botany; one to be sure which is not without its value; but it is only the most elementary part of the subject. It was very natural that when people began, in the revival of learning, and at the close of the middle ages, to study plants, they should first turn their attention to the plants which were nearest at hand, and to those plants which attracted their attention most readily on account of their size. So we find that the early studies of plants are almost exclusively an attempt to describe and classify; at first simply to describe the plants which one found about him; later to ascertain what the relations of these plants to each other were. From that day until the present this study and classification of the higher plants has been almost the only subject to which any very great attention has been given. In our own country the people who came to it, if they had had any training at all in botany, had been impressed with the importance of the same ideas. They had come to a new country. It was their first duty to make known to those abroad who were studying plants, what the flora of this country was; and, from the year 1750 on, collections of great number and often of considerable value went across the water.

From 1750 to late in the present century little attention was given to any other department of botany; and it is only within the last ten or fifteen years that descriptive botany has had any competitors for favor. In Germany, however, the matter is widely different; it has been a much longer time since systematic botany, the study of plants as far as their classification is concerned, was the only topic which attracted attention. The reason of this is perfectly evident. People exhausted the subject to a certain degree in that country, and they then naturally turned their attention to some other phase of plant study. Germany and France stand far in advance of this country to-day in the investigations which their botanists have pursued, solely because of the longer time during which they have been at work, and the greater amount of time which each investigator is able to give to his own special subject.

But students nowadays are not expected to collect flowers and find out their names and then congratulate themselves that they have studied botany. They are put to work with the microscope to see the very minutest arrangement of the complicated machinery of plants. They are set to work with the pencil to delineate these arrangements; to record their observation in a way which appeals at once to the eye, without the intervention of words; and, in spite of the repeated assertion that they cannot draw, they are told to do the very thing which they cannot do until they have learned how to do it. They are asked to equip themselves with chemical and physical knowledge, in order that they may be able to study this machinery in action; and when they have attained a sufficient knowledge of other sciences, then, and then only, can they expect to unravel some of the mysteries of plant life, in many ways the least mysterious of organic things.

Now, what is the object and purpose of such training as this? First, it is to develop skill of eye, hand, and brain. It is to bring to them something of those qualities to which the essayist of the evening alluded. It is to enable them to see in the material things around them something more than bits of matter. It is to enable them to gain that breadth of comprehension and grasp of intellect which it is desirable that every educated man should attain. I hope, therefore, that the members of this society will use their utmost endeavor to have this sort of vital and vitalizing study commenced in the schools below the college and university; in what we may call the primary schools as contrasted with the secondary ones. Most of the high schools in the State to-day, I am sorry to say, are studying this subject in the same way in which it was studied twenty-five years ago, and they are doing this work partly because they have had no pull from higher schools to lift them to a higher level, and partly because they know no better way.

On its economic side this sort of training has its chief value, and it is that, I take it, in which the members of this society are mainly interested. Let me select a few topics from the very great number at my disposal in order to illustrate to you, if I can, just what the economic bearing of this

[1] An address delivered before the State Agricultural Society of Wisconsin, Feb. 1, 1892; stenographically reported and published by permission of the secretary in advance of the volume of Proceedings for the year.

science is; just what we may expect from it; just what we have a right to demand from it.

Take the single topic of the culture of plants. In how far has that been exhausted? How much do we really know about the reasonableness of our modes of cultivation? How much do we know about the effect of other modes of cultivation than those which have been in vogue for fifty, or one hundred, or hundreds of years? One suggestion in this direction may suffice as an illustration. If any man should sow Indian corn in the same way that he sows wheat, with the expectation of obtaining any crop of grain from it, we should almost consider him an idiot. And yet I wonder whether it is very much less idiotic to sow wheat in the way that we do, with the expectation of attaining the best results possible from this as a grain crop. I do not say that we do not get a crop, often a good crop. A magnificent one, as compared with what we have ever had, has been raised in the past year; but who knows whether the cultivation of wheat in something the same way in which Indian corn is cultivated, that is, by giving it a much greater range for obtaining its nourishment, and better advantages of light and air, would not increase the yield by a very large percentage? Indeed, there have been some experiments, on not a very small scale, which would seem to indicate that there are possibilities in this direction which we have not yet even attempted to ascertain.

You hear a great deal from our own university experiment station about the food of animals; and Professor Henry is constantly experimenting to ascertain just what are the best foods to produce a given result with a given animal. He has endeavored to ascertain something of the effect of different rations upon the bones, upon the muscles, upon the fat of various animals. Why should we not have some experiments carried on in regard to the food of plants? Does anybody know what the effect of a given ration of food for a plant will be? So far as I can recollect, experiments on what we may designate as feeding plants, have been carried on to a very limited extent. We have endeavored to ascertain particularly where plants obtain their nitrogen; and for the last twenty-five years, almost, this question has been one under experiment and under discussion. I suppose that many of you know something of the prolonged experiment which has been carried on at Rothamstead; and perhaps some of you know of the recent experiments of Hellriegel and Wilfarth, and Frank, men who are endeavoring to find out whether plants, when kept in very vigorous condition, can obtain nitrogen from the air, or whether it is absolutely necessary to get it from compounds in the soil. Here is a problem which has been attacked in the way these other questions ought to be attacked, and in the very way in which we may expect a solution of these thousands of other problems in regard to feeding plants. The most recent experiments in regard to this source of nitrogen for plants make it quite possible that when plants are in a very vigorous and thrifty condition they are then able to fix the free nitrogen of the air; and that when they are not at their highest notch of vigor, they are then able to get their supply of nitrogen only from nitrogenous compounds in the soil. On this very point we have some recent experiments that perhaps would interest you; and, bear in mind, I am only mentioning these as illustrative. I am trying to show the necessity for such a preparation in botanical study as will enable the men who are most deeply and profoundly interested in this very study to carry on some of those experiments that it seems so highly desirable to carry on.

Only a few months ago a paper was published by two of the men who have been experimenting longest on this matter of nitrogen assimilation; and they give some hints in regard to the harvesting of those plants which produce large quantities of nitrogenous material that may turn out to be of very great money value. It has been found that the contents of leaves of clover, so far as nitrogen was concerned, was very much greater at the close of the day, or near the close of the day, than it was in the morning or during the forenoon. That is, during the day, especially on bright and sunny days, the plants were able to manufacture large quantities of these materials. Now one of the main things for which our clover crop is grown is the large amount of nitrogenous materials which it contains as compared with other fodders. It is quite plain that if these results are correct, the harvesting of such a crop as this near the close of the day is going to give us a fodder whose money value is decidedly greater than that of one harvested early in the day, before the plant has been able to manufacture these substances; for in the course of the night the large majority of them are utilized for the plant's own growth, and are converted into other forms of material which are less valuable as animal food.

But I cannot dwell upon that topic. Let me give you a hint from another field. Perhaps if I should ask any of you what is the purpose of the shade-trees along the streets of our cities and villages the answer would be quite unanimous that these trees were for shade and beauty; and yet these trees are not used for that purpose. At least nobody, I think, would imagine that that was their use, if he passed along the streets of our own city. He would think that the main purpose of the best elms was to furnish adequate stays for some electric pole or to support the telephone wires which pass through them. He would suppose, if he saw the city force making a street, that the chief purpose of the roots of the trees was to be grubbed out of the way for the first curbstone or sidewalk that the city wished to put along that way. If one saw people trimming their shade-trees, he would think that the main advantage of these was to afford an object lesson as to how badly work could be done, and how much injury could be inflicted upon an unoffending plant, apparently with the intention of affording it early relief from its sufferings by death. Our treatment of shade-trees in the streets of cities and villages is one of the crying shames of this day. Watch the "trimming" of street trees. Ignorant laborers half chop and half break off the limb of a tree, and leave the rough end exposed to wind and weather instead of caring for the wound properly. We seem to think we have no more duties towards that particular tree except to ged rid of a branch that may be a little bit in our way. We do the very thing which will subject that tree to the greatest danger. We offer the very best chance for the attack of parasitic animals and plants on that tree; as though our main purpose was to destroy it, instead of our alleged intent, to trim it in order to maintain and augment its beauty.

This naturally suggests the management of forests. *Management* of forests? We hardly know of such a thing in this country. We do not manage our forests. We simply cut them down, and then are glad that the cutters can move on to some other acre and cut it down in the same way. We have made almost no provision in this country for maintaining our supply of timber. People may say what they please about the inexhaustibility of our forest resources. Those of you who have given the subject any attention know that it is utter folly to say that our forest resources are inexhaustible, or that they are not being exhausted at a most extrava-

gant rate. Now men trained in the knowledge of how plants live and grow and behave have some basis on which they can suggest ways of managing forests which will not only yield all the timber that is needed at the present time, but which will enable these forests to continue to yield such supplies for an indefinite period of years. Forest management is not unknown in other countries. We simply have trained no men in this country to have any idea what forest management means.

And then we have the immense subject of diseases of plants, and that is a study which seems to have attracted the greatest attention at the present day. The division of vegetable pathology at the Department of Agriculture at Washington is receiving a vast deal more attention than the division of forestry, and yet I doubt very much whether its money value to the people is any greater. The money value of the study of *both* these subjects to the American people, and *particularly to the farmers of the country*, is almost beyond calculation. We hardly realize what this money value is. We are so used to losing a certain percentage of our farm crops by diseases that we really pay no attention to it. If our animals, our flocks and herds, should be decimated as often as the crops are, we should hear such a hue and cry as would bring immediate attention on all hands to it. I suppose there is no one of you, who has given the subject a moment's thought, but will agree with me that the loss from rust on the wheat crop for the present year, stated in the very lowest possible terms, could not fall below one per cent. How much money does that mean on six hundred odd million bushels of wheat? It means several million more than has been laid out in the study of plants in all the centuries. It means a great many hundreds of thousands of dollars more than we shall lay out the next century for the study of plants; and yet we are learning and can learn how not only to check but how absolutely to prevent such diseases as this. I do not say that this particular one can be absolutely checked at the present time, but we know ways in which it can be reduced to a minimum, even at present. The same thing might be said in regard to such diseases as those of the smut in corn and oats. Very careful estimates of certain years have shown us that as much as ten per cent sometimes of an oat crop is damaged by that one disease alone. That might mean a good many millions of dollars on that one crop. So that a study of these plant diseases is by no means either fruitless or valueless.

But you say, "Why not let anybody who is concerned with these matters study them?" Chiefly because it is not possible for any man who does not know something of the life history of the parasite which causes a disease to go about checking or curing it. He may guess at some remedy, and he may, by a lucky guess, hit upon the right remedy. He may think of some process that possibly will turn out the right one, but he is not nearly so apt to think about the right process or to hit upon the right experiment as the man who has been properly trained for this kind of work. That sort of training means *time* to study, and *time* to work, and *money support* while the work is being carried on.

I might dwell at very much greater length on these various topics; but enough has been said, I hope, to give you some idea of what modern botany is and what the modern botanist is. It will at least give you a truer idea than you would have if you considered him *merely* as the man who goes out and gathers some plants, useful as this may be, or the man who tears apart some flowers to find out what the names of the flowers are. Rather, I would have you think of the botanists of the country as those men who are studying means of discovering, checking, and curing the plant diseases; men who are studying how plants grow, and how they may be helped in their growth and not harmed. They are men who are studying what is the rational basis for our modes of culture; and it is to these men the agriculturist must turn, with the hope that their experiments will lead him in the future, as they have in the past, to more rational modes of cultivation, and to better knowledge of the organisms, the very intricate organisms in spite of their simplicity, with which he has constantly to deal.

NOTES ON A DESTRUCTIVE FOREST TREE SCOLYTID.

BY ANDREW D. HOPKINS.

THE family of beetles known as Scolytidæ contains in this country, so far as known, something over 160 species. They are small, cylindrical, brown or black beetles. The largest one of the family, *Dendroctonus terebrans*, is thirty-two hundredths of an inch long, while the smallest, *Cripturgus atomus*, is but four hundredths of an inch long. With a few exceptions, beetles belonging to this family breed in the bark of wood of different forest and fruit trees. Each species usually has a preference for certain kinds of trees. Those feeding on the bark are called bark beetles, while those entering the wood are termed timber beetles. The bark beetles breed in and feed upon the inner bark of trees or logs, and when fully developed emerge through the bark, leaving it pierced with small round holes. The timber beetles enter directly through the bark, making their "pin-hole" tunnels in all directions through the wood; their eggs are deposited in these tunnels, and when the young are fully developed they emerge from the original entrance made by the parent beetle.

It has been claimed that Scolytids never attack healthy, living trees. We acknowledge that as a rule the different species of this family have a preference for unhealthy trees or those which have been broken by storm or felled by the axe, but in this *Dendroctonus frontalis* we certainly have an exception to the rule. From the abundant evidence I have obtained during extended and careful investigation, I am convinced that the death of large and small, vigorous trees of five species of pine and of the black spruce was caused primarily by the attack of this insect; in fact, this species seems to have a preference for the green bark on the living pine and spruce which they invade.

As Entomologist of this Station, I have conducted some investigations regarding the ravages of this beetle, and, since May 2 of this year, have travelled about 340 miles through some of the principal regions of the State, where the pine and spruce are most common. The species of pine observed were the White Pine (*Pinus alba*), the Yellow Pine (*P. echinata*), the Pitch Pine (*P. rigida*), the Table Mountain Pine (*P. pungens*), and the common Scrub Pine (*P. inops*). The Black Spruce (*Picea Mariana*) is also a common and valuable tree on some 500,000 acres of the higher mountains and table-lands of this State.

Trees varying from five inches in diameter to the largest, finest specimens of the five species of pine mentioned, and of the Black Spruce, were found dying in different sections from a cause which it was my duty to investigate. A large number of the dead, dying, and green trees were felled and examined. Every part of the trees from the roots near the surface to the terminal twigs and leaves was carefully

searched for possible causes of their unhealthy condition. The trees in the best condition to examine were those on which the leaves were yet green, but from their general appearance indicated that they had been attacked by the characteristic trouble which was shown in a few yellow leaves at the tops. The roots of such trees were found in a perfectly healthy condition for some distance beneath the surface; the bark on the trunks from a distance of from five to fifteen feet from the base was green, full of sap, and apparently healthy; the leaves were almost free from insect attack and disease, in no case was there sufficient attack of this nature to indicate even a slight injury; the bark, however, at a point about two-thirds up from the base of the tree, was found in every case to be infested by *Dendroctonus frontalis* in sufficient numbers to kill all the bark for some distance above that point, and in this bark fully-developed beetles and pupæ were found on May 5, thus indicating that the eggs must have been deposited in the bark the previous summer or fall. All of the characteristic dead and dying Pine and Spruce trees examined showed abundant evidence that they had been invaded while yet green by this bark beetle.

It would seem that the turpentine escaping into the burrows made by the beetles in the green bark would render the conditions unfavorable for the progress of their work. They have, however, the power of removing it from their burrows, and they manipulate the sticky resinous substance with seemingly as much ease and in a like manner as the crawfish does the clay it piles up around its burrow. Often a half teaspoonful of the turpentine will be found massed about the entrance to the burrows made by the beetle. They push the turpentine out through a hole kept open in the pitchy, adhesive mass. I have observed them backing out from the entrance, shoving behind them a quantity of the turpentine, and at the same time they would be completely enveloped in it.

Trees invaded by these beetles the previous fall may remain green until spring when they are usually attacked by the large *Dendroctonus terebrans*, *Hylurgops glabratus*, and *Tomicus calligraphus*, the two former at the base of the tree, the latter in the green bark above. They are in turn followed by numerous other species of bark and timber beetles until the invaded trees may be, as I have found, the hosts of at least twenty-five species of scolytids coming like reinforcements to the aid of *D. frontalis* to make doubly sure the death of the invaded trees. Later on, these scolytids are followed by insects belonging to other families until a dead or dying tree may be the host of hundreds of species and millions of examples, breeding in and feeding upon every part of the tree from the base to the terminal twigs, rendering it worthless for lumber within a year after it dies.

Thus it will be seen that *Dendroctonus frontalis* may be the primary cause of not only the death of the trees but of their rapid decay.

West Va. Agricultural Experiment Station, Morgantown, West Va., July 20.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Auroral Display.

On Saturday evening, July 16, there was visible, from this locality, in the northern heavens, the most brilliant auroral display which I have witnessed since the year 1859. Besides the usual exhibition of streamers of various hues, dancing along the northern arch like great hanging curtains, there was one most unique feature which I never saw or heard of before. A little after 10 o'clock, when the great brilliance of red and pink streams seemed to be dying out, and the northern heavens assuming a pale uniform hue, there appeared directly overhead a well-defined, nebulous arch, spanning the entire vault of heaven from east to west. At first a companion suggested that it was the Milky Way; but a few seconds' observation detected the Milky Way, running nearly at right angles with the arch — the two resembling each other somewhat in width and general appearance, except that the arch was more clearly defined and uniform in shape and outline than the other. In about fifteen minutes it began to fade away and disappear, the eastern portion disappearing first. In a short time there was only a bright strip near the western horizon, which much resembled the tail of a comet; but it, too, soon disappeared, and there were then no traces of the arch to be seen.

However, in a few minutes it began to reappear, and soon shone out bright and clear as before,— the arch being five to six degrees in width,— the eastern extremity at the horizon being a little south of east, and the other extremity being a little north of west, as if the whole had been drawn by a radius of a circle whose centre was a little east of the north pole. In ten or fifteen minutes this arch also disappeared as before.

Between the arch and the upper extremities of the gay streamers in the north there were several degrees of space lighted up by stars, and without any apparent connection between them. The band or arch seemed wider at the zenith than on either horizon — probably the effect of the greater distance of the horizon points from the position of the observer. The night air was quite cool, and I retired before midnight; and I have not learned whether or not the arch again reappeared. T. A. BEREMAN.

Mount Pleasant, Ia., July 20.

Magnetic Storm, Aurora, and Sun-Spots.

A MAGNETIC storm raged here from 10.30 A.M to 4.30 P.M., central time, on Saturday, July 16, 1892. An electro-magnetic wave reached the general telegraph office of the C. B. & Q. R. R. at 10.30 A.M., making it difficult to operate, especially with the quadruplex. The duration of the electric disturbance was six hours; but the impulses came with varying intensity. The energy always appeared as a wave, beat, or oscillation; and when fully developed in the wires, seemed to set up a counter electro-motive force in opposition to the batteries. The fact that electro-magnetic energy traverses space in the form of waves, coincides with the now classical experiments of Hertz, who projected these waves not only through space, but brick walls. Perhaps a law like this will be discovered — *All modes of energy alternate.*

It is doubtful if a constant pressure exists in nature. In some instances, telegrams have been sent by means of nature's electricity — without batteries. This is merely a prophecy of that time coming when men will appropriate electricity when they want it, as they do light and heat.

An aurora appeared at 9.40 P.M., and consisted of many pearl-colored columns, at times tinged with red, occupying more than 100° in azimuth, and all converging near Polaris.

At 9.45 an apparition unusual in auroral displays was seen. This was a streamer of nearly white light, that, starting in a sharp point almost on the horizon, in the north-west, shot with great velocity north of Arcturus, passed over Corona Borealis, which constellation it equalled in diameter, crossed Hercules and Cerberus, and, passing over Altair, descended almost to Mars in the south-east, terminating also in a fine point.

This majestic sword moved bodily 10° to the south, and, after shivering and pulsating throughout its length three times, vanished, after existing fourteen minutes. The whole aurora lasted forty minutes. On July 9, a large cluster of spots, with two smaller groups and one larger isolated spot, were seen on the sun. All the larger spots had bridges, and on the 12th and 13th the tongues across the large one began to curve, which curvature rapidly increased on the 14th and 15th. On the 16th, these jets were arranged nearly in a circle, or had assumed

the twisting, rotary, or cyclonic form. One of the tongues was brighter than the solar surface, and seemed to be the most brilliant at from 9 30 to 10.30 A.M., at which time the electric wave disturbed the telegraphs. Whether the solar turbulence causes terrestrial magnetic upheavals is a question that future physicists must decide.

A sun-spot maximum is drawing near, and already there are lively electro-magnetic times. EDGAR L. LARKIN.

Knox College Observatory, July 19.

The Crinoid Heterocrinus Subcrassus.

TWO or three years since, I concluded to find out, if I could, the character of the termination of the column of the crinoid Heterocrinus subcrassus. Having a lower silurian slab with about one hundred specimens of the calyx, with a great profusion of the columns diverging in every direction, I selected a culumn attached to its calyx, and followed it by uncovering, until I was rewarded by discovering the column diverging into well-defined roots; length of column from calyx 12¼ inches, about 1½ inches under the surface.

At that time I believed that the genus Glyptocrinus were floaters, and devoid of bases, or roots.

About eighteen months ago something caused me to doubt that idea, and I commenced the investigation of the terminations of their columns, and now, after a great deal of work, and after many discouragements, I have been able to so far develop roots on the terminations of the columns of Glyptocrinus neali, Glypt. dyeri, and Glypt. baeri, that I have a specimen of each species, showing the calyx, column, and roots intact, on the slab, one slab of Glypt. baeri having on its surface several specimens of that character.

One character of the specimens surprised me,— the diversity of the length of the columns between calyx and roots in the specimens just mentioned, the column of Glypt. neali, from two to four or five inches; Glypt baeri, from one-half an inch to six or eight; Glypt dyeri, from one to four or five inches between calyx and roots.

I have also found a specimen of Heterocrinus simplex, showing calyx, column, and inverted saucer-like base, attached to another column. DR. D. T. D. DYCHE.

Lebanon, O.

Professor Parker's Further Studies on the Apteryx

IN No. 485 of *Science* the writer invited attention to the very valuable contributions to our knowledge of the morphology of Apteryx that had been made by Professor T. J. Parker, F.R.S., of the Otago Museum (New Zealand). Those investigations have been continued on more extensive material, and the London Royal Society have just published in their Transactions (1892) the results, in a paper entitled "Additional Observation on the Development of Apteryx" (11 pages; two col. lith. plates, of 19 figs.). Professor Parker has kindly sent me a copy of this work, and I desire to say, in the present connection, in continuation of what already has been noted by me in my former review, that more advanced embryos of the bird under investigation (stage F^1) show "the pollex is unusually large, and the fore-limb has the characters of the wing of a typical bird." Better figures are given than in the first paper, showing structures of the brain and skull, and also that one "specimen exhibits an unusual mode of termination of the notochord." In other figures (stage G') the final form of the chondrocranium, before the appearance of cartilage bones, is shown, and, what is a very interesting fact, "that in *A. oweni* there is always a solid coracoid region to the shoulder-girdle, while in *A. australis*, as far back as stage F', there is a coracoid fenestra and a ligamentous procoracoid." Finally, it is worthy of note that "in addition to the elements described in the corpus an intermedium may be present" As I have already said, the working out of these anatomical characters, in such an important form as Apteryx, will most certainly prove to be of the highest importance and use to the general comparative anatomist the world over. There could be no safer hand to accomplish it for us than that of the distinguished biologist of the Otago Museum. R. W. SHUFELDT.

Takoma, D.C., July 24.

A Satellite of the Moon

I HAVE seen accounts of an attempt to discover whether the moon has a satellite, and the accounts that have reached me seem to show one serious fault in the procedure. While I am not thoroughly conversant with all the points involved, it does seem to me, that, in taking a photograph of the region in which such a satellite would be found if it exists, the apparatus should be arranged with reference to stellar motion, and leave the moon out of question. Of course, the moon would be blurred, but we are not concerned about that. The fixed stars would appear plainly on the plate, while any one that had a motion different from theirs, especially a rapid motion such as a satellite of the moon must have, would appear blurred on the plate; in which case only the blurred stars, if such occurred, need be examined with any hope of finding a satellite of the moon. C. P. MAXWELL.

Dublin, Tex., July 20.

Auroral Display.

ON Saturday night, July 16, 1892, I was returning to my home in Rockville, Indiana, from Clinton, Indiana, sixteen miles southwest. Mr. Harry McIntosh, a young man of this place who had been helping me make a survey near Clinton, was riding with me in my buggy. We amused ourselves looking at a most beautiful sunset as we rode over the Lafayette and Terre Haute road, along the foot of the high hills east of the Wabash River.

When we turned eastward, over the hills toward Rockville, it began to grow dark, and most of the clouds that showed up so beautiful at sunset began to vanish, till only a few streaks of stratus clouds remained. As we were descending the west hill at Iron Creek, five miles south-west of Rockville, we saw in front of us what we supposed was the new electric light at Rockville, thrown upward and reflected from a cloud or mist. As we were ascending the hill on the east side of the creek and near its summit, we saw in our front the reflection of a great light from behind us. It was so noticeable as to cause us both to turn about on our buggy seat and look backward. There, at a bearing S. 60° W. (that is the bearing of the road, with which the light was in alinement), we saw a great white light radiating from a point at the horizon where it was brightest, right, left, and upward to a height of 10° to 15°, weakening in brilliancy as it radiated and terminated in a dark band or segment of rainbow shape, some 10° wide. The light seemed to radiate from a point a half-radius above the centre of the circle which the black segment would indicate. Above the dark segment another segment or band of light, not so bright as the one at the horizon, formed a rainbow, or arch, some 10° to 15° wide. Above that second band of light was a light haze, or mist, through which the stars could be easily distinguished. Some 10° up in that mist, and directly over the centre of the light at the horizon, was a light about as large as a man would appear to be if suspended from a balloon a thousand feet distant. It was about four times as long vertically as wide horizontally. Young McIntosh saw it first and called my attention to it, as I was watching the bright light at the horizon. When I first caught sight of it, it had the appearance of the head of a comet, only it was long vertically. When young McIntosh first saw it, it seemed to be a blaze such as a large meteor appears to carry at its front. We halted and watched it about ten minutes, during which time it (the small light) slowly faded till only its locality could barely be noticed, then suddenly loomed bright almost to a white blaze, then slowly faded as before. It would loom up in five seconds, and consume five minutes in fading away. It kept the same position all the time, for we watched its position with relation to the stars to see if it moved. At this second appearance I decided to commit the general appearance to memory so I could sketch it afterward This little light loomed up and faded four times when the big light under it faded also and made it dark there.

I am not sure we saw this light the first time it appeared, but think we did. The small light above looked as the moon does when shining through a thin cloud, except as to the oblong shape vertically.

When the first or south-western light faded nearly out, a light

at the horizon in the south loomed up, but not so bright as the first, nor had it any of the upper characteristics of the first, nor did it last over five minutes. When this second light faded a third loomed up in the north, quite as bright at the horizon as the first, but it was obscured or cut off from our view by a stratus cloud. This cloud was about 10° above the horizon, at its under side (which, by the way, was its most northern limit). This limit, I judge from my frequent observation of clouds, was fully twenty-five miles north of us. We could see the light through one hole in the cloud near its bottom (or distant) side, and also through several thin places, but could not determine its upper shape. This third light (counting the southwestern light as the first) lasted about five minutes, when a fourth light loomed up in the north-west, and, very bright at the horizon, reached upward about 15°, lasted a few minutes, and faded out as did the others. Then one appeared in the north-east, in the direction of Rockville; but we were so near the town we were sure it was the new electric light (we had been gone a week), but on entering the town found the old gasoline lamps still doing service.

On the first appearance of these lights at the horizon, I thought I saw a flash of light, not as a blaze, but as if a mirror had been turned so as to flash the light into my face, then away so quick I could not be certain what I saw. Young McIntosh thought he saw the same flashes of light when the great lights first made their appearance.

I saw this same electrical storm (if that is what it is) in the summer of 1884, from the town of Clinton, Indiana, and in July, I think. It had all the features I have given of this, except the one in the south-west with its three lights and dark segment, herein described. The Clinton display was watched by apparently the whole population of the place, and was described by the Clinton *Argus* at the time. I reported it to the U. S. Signal Office at the time, as I was then making voluntary observations for that office.

The small light I have described as seen in the south-west, in the first light last Saturday night, is a new feature, so far as I know or can learn from my authorities. These lights occurred from about half past nine to half past ten o'clock at night.

I wish to hear from others who may have seen these lights, by letter or paper containing published account of them.

Rockville, Ind., July 17. JOHN T. CAMPBELL.

BOOK-REVIEWS.

Geological Survey of New Jersey. Annual Report of the State Geologist for the year 1891. Trenton, 1892. Maps and plates.

To this report Professor R. D. Salisbury contributes a paper called "A preliminary paper on drift or Pleistocene formations of New Jersey." The title is somewhat misleading, inasmuch as there are few statements in it concerning the New Jersey formations. It embraces mainly an account of the nature of the drift, the formation and movements of glacial ice, the work effected by ice, and a summary of the development, movements, and work accomplished by the ice-sheet of North America. New Jersey is incidentally mentioned, and the only new contribution made is the statement concerning the discovery of the remains of a once extensive drift-deposit south of the terminal moraine. It is concluded that this was deposited by an ice-sheet previous to the formation of the great moraine; and that "the interval which elapsed between the first and the last glacial formations of New Jersey was several times as long as that which has elapsed since the last." Assistant Geologist C. W. Coman contributes an interesting paper on the oak and pine lands of southern New Jersey. The topographical survey showed that in 1888 there were only 430,730 acres of cleared land in the southern counties, against 1,326,000 acres of forest. The proportion has not been greatly altered since. Both uplands and swamps are heavily covered with timber, much of which is valuable for various purposes. "From a little distance a cedar swamp presents the appearance of a solid mass of dark green, while even when in the midst of it the eye can penetrate but a few yards among the thickly clustering, smooth, gray trunks. The gum and maple swamps are scarcely less dense, and are even more difficult to penetrate, because of the abundance of underbrush, amid which the poison sumac, *Rhus venenata*, is sure to be encountered by the unwary. The trees are often very large, exceeding 100 feet in height. The demand for white cedar for shingles, siding, planking for boats, and such other purposes as require great durability under exposure to the weather, far exceeds the supply." Much of the uncleared land is well adapted for fruit raising and "truck" gardening, and there is still room for a large addition to the permanent population of the State.

Mr. C. C. Vermeule, the consulting engineer and topographer of the survey, gives a comprehensive review of the water supply and water power of the State, with tables of rain-fall and evaporation, and accounts of the guaging of numerous rivers. A table is also given of all the water powers, with mention of the owner, kind of mill, fall, and horse-power. It is the intention to publish the full report on water power in the State as Volume III. of the final report some time during the present year. Finally, notes are given by other hands on artesian wells, on the Passaic River drainage and the active iron mines in the State. The information given cannot fail to be of value to the inhabitants of the commonwealth. JOSEPH F. JAMES.

Nature Readers — Seaside and Wayside, No. 4. By JULIA MCNAIR WRIGHT. Boston, D. C. Heath & Co. 1892. 8°. 361 p. 70 cents.

This volume is one of a series of reading-books written, the author tells us, "to direct the minds of our youth in their first studies to the pleasant ways of Natural Science." The earlier numbers of the series were devoted to lessons on the habits of animals and plants, but the present volume deals with a much wider range of subjects. The book begins with a lesson on the origin and structure of the globe and passes on to the consideration of the geological epochs and of the animals and plants that characterize them. It is, in fact, a collection of brief essays on important topics in astronomy, geology, palæontology, and zoology. The diversity of topics would seem calculated to cause confusion in the mind of a child; but this is, perhaps, an evil inseparable from the modern system of education.

Though the facts are presented in a somewhat too fanciful dress, the information is for the most part accurate, and the author has taken great pains to point out that there are exceptions to many of the general statements. She has included, so far as possible, the results of the latest investigations.

A few noticeable errors should be corrected. For example, the pig is made to figure as a typical odd-toed ungulate (p. 349). On page 300 the sperm whale is mentioned as the "Greenland sperm whale," which is, of course, misleading, as this animal is only very rarely found in Arctic waters. In another place (p. 148) the author refers to the squirrels and rats as being the first mammals to appear on the globe, a statement which no palæontologist would accept. We notice again (p. 320) that the vampire bats are described as "very large bats given to blood-sucking." This is quite erroneous, as the true vampires, *Desmodus* and *Diphylla*, are small bats, remarkable chiefly in the modification of their teeth and digestive organs.

The influence of English text books is apparent in different parts of the volume. The common mole, for example, is described under the name of the European genus *Talpa;* although as the book is presumably intended for American children, it would have been better to mention *Scalops* or *Scapanus*, to which genera the commonest American moles belong. We can hardly find fault with our author in this instance, however, seeing that no general treatise on American mammals has been published for nearly half a century.

In the illustrations, with which the book is well supplied, artistic effect has been aimed at rather than strict accuracy; a number of them are entirely fanciful and represent only creatures of the imagination. They could be replaced to advantage, in our opinion, by figures of some of the real wonders of animate nature.

In spite of these defects the book is a good representative of its class, and the lessons will doubtless be read by children with interest and profit. F. W. T.

A Text-Book of Physiology. By M. FOSTER, M.D. Sixth Edition, Revised. Part IV. (comprising the remainder of Book III., The Senses and Some Special Muscular Mechanisms, and Book IV., The Tissues and Mechanisms of Reproduction). New York, Macmillan & Co. 1891.

WITHOUT doubt Foster's "Text-Book of Physiology" must be accorded the foremost place among the works upon this subject, which have been published in the English language. It embodies the results of the most recent researches in this department of biological science, and is not only comprehensive, up to date, and accurate, but is admirably arranged and most convenient as an encyclopædic work of reference upon all that relates to the subject.

A large portion of the present volume is devoted to the senses, including sight, auditory sensations, olfactory sensations, gustatory sensations, cutaneous sensations, the muscular sense, and tactile perceptions and judgments. Each of these subjects is treated in a masterly manner, the anatomical elements concerned in each special sense being minutely described, and the facts and theories relating to the perception of various sensations being fully detailed.

Chapter VII., "On Some Special Muscular Mechanisms," contains three sections: one devoted to the voice, one to speech, and one to walking.

Book IV., which concludes the volume and the work, gives a very satisfactory account of "the tissues and mechanisms of reproduction."

Diphtheria, Its Natural History and Prevention. By R. THORNE THORNE, Assistant Medical Officer to Her Majesty's Local Government Board. London and New York, Macmillan & Co. 1891.

THIS is a valuable résumé of what is known at the present day with reference to the etiology and prevention of diphtheria. The volume abounds in interesting details relating to the prevalence of the disease in England and Wales, and gives numerous facts showing the not infrequent transmission of the disease by contaminated milk and its probable transmission by cats, which have been proved to be subject to the disease as a result of experimental inoculations in the trachea with bits of diphtheritic membrane, or cultures of the Klebs-Löffler diphtheria bacillus.

According to Thorne Thorne there has been a progressive increase in the mortality from diphtheria in England and Wales during the past twenty years, and this progressive increase has coincided in time with steady improvement in regard to such sanitary circumstances as water-supply, sewerage, and drainage; and also with a continuous diminution in the death-rate from the group of zymotic diseases and from typhoid fever.

The diphtheria mortality remains, as heretofore, greater in the sparsely-peopled districts, but there is a marked increase in its prevalence in large towns and cities.

Publications Received at Editor's Office.

BENOTIRE, CAPT, CHARLES. Life Histories of American Birds. Washington, Government. 4°. Paper. 413 p. Ill.

CHADWICK, FRENCH E. Temperament, Disease and Health. New York, G. P. Putnam's Sons. 8°. 85 p. 75 cts.

DALL, WILLIAM H. Instructions for Collecting Mollusks. Washington, Government. 8°. Paper. 56 p.

MOOREHEAD, WARREN K. Primitive Man in Ohio. New York, G. P. Putnam's Sons. 8°. 262 p. $3.

PHILOSOPHICAL SOCIETY OF WASHINGTON. Bulletin 1888–91. Washington, The Society. 8°. 652 p.

RIDGWAY, ROBERT. The Humming Birds. Washington, Government 8°. Paper. 381 p.

RILEY, C. F. Directions for Collecting and Preserving Insects. Washington, Government. 8°. paper. 147 p.

UNIVERSITY OF MINNESOTA. Quarterly Bulletin. Vol. I., No. 1. 4°. Paper. 32 p.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Taxidermist going out of business has quantity of finely-mounted specimens of North American birds, mammals and reptiles and skins of birds for sale, including a full local collection of bird skins, showing some great variations of species; also quantity of skulls with horns of deer and mountain sheep, and mounted heads of same. Will give good exchange for Hawk Eye camera with outfit. Apply quickly to J. R. Thurston, 265 Yonge St., Toronto, Canada.

For exchange.—A fine thirteen-keyed flute in leather covered case, for a photograph camera suitable for making lantern slides. Flute cost $27, and is nearly new. U. O. COX, Mankato, Minn.

To exchange; Experiment Station bulletins and reports for bulletins and reports not in my file. I will send list of what I have for exchange. P. H. ROLFS, Lake City, Florida.

Finished specimens of all colors of Vermont marble for fine fossils or crystals. Will be given only for valuable specimens because of the cost of polishing. GEO. W. PERRY, State Geologist, Rutland, Vt.

For exchange.—Three copies of "American State Papers Bearing on Sunday Legislation," 1891, $2.50, new and unused, for "The Sabbath," by Harmon Kingsbury, 1840; "The Sabbath," by A. A. Phelps, 1842; "History of the Institution of the Sabbath Day, Its Uses and Abuses," by W. L. Fisher, 1859; "Humorous Phases of the Law," by Irving Browne; or other works amounting to value of books exchanged, on the question of governmental legislation in reference to religion, personal liberty, etc. If preferred, I will sell "American State Papers," and buy other books on the subject. WILLIAM ADDISON BLAKELY, Chicago, Ill.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g. to 1-10mg.), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862–1885 (62–71 bound); Smithsonian Reports, 1854–1883; U. S. Coast Survey, 1854–1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

Wanted, in exchange for the following works, any standard works on Surgery and on Diseases of Children: Wilson's "American Ornithology," 3 vols.; Coues' "Birds of the Northwest" and "Birds of the Colorado Valley," 2 vols.; Minot's "Land and Game Birds of New England;" Samuels' "Our Northern and Eastern Birds;" all the Reports on the Birds of the Pacific R. R. Survey, bound in 2 vols., morocco; and a complete set of the Reports of the Arkansas Geological Survey. Please give editions and dates in corresponding. R. ELLSWORTH CALL, High School, Des Moines, Iowa.

To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

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WANTED.—The services of a wide-awake young man, as correspondent, in a large manufacturing optical business; one preferred who has a thorough knowledge of microscopy and some knowledge of photography. Address by letter, stating age and references. Optical, care of Science, 874 Broadway, New York.

WANTED.—We want any and all of the following, providing we can trade other books and magazines or buy them cheap for cash: Academy, London, vol. 1 to 28, 35, Jan. and Feb., '89; Age of Steel, vol. 1 to 66; American Antiquarian, vol. 1, 2; American Architect, vol. 1 to 6, 9; American Art Review, vol. 3; American Field, vol. 1 to 21; American Geologist, vol. 1 to 6; American Machinist, vol. 1 to 4; Art Amateur, vol. 1 to 7, Oct., '4; Art Interchange, vol. 1 to 9; Art Union, vol. 1 to 4, Jan., '44, July, '45; Bibliotheca Sacra, vol. 1 to 46; Godey's Lady's Book, vol. 1 to 20; New Englander, vol. 11; Zoologist, Series 1 and 1, Series 3 vol. 1 to 14; Allen Armendale (a novel). Raymer's "Old Book" Store, 243 4th Ave. S., Minneapolis, Minn.

WANTED.—By a young man, a Swarthmore College junior, a position as principal of a public high school in one of the Gulf States, or as instructor in botany, physiology, and geology in an academy or normal school. Address B., care of Librarian, Swarthmore College, Penn.

WANTED.—To act as correspondent for one or two daily or weekly papers. Have worked on paper for about two years Would like a position on editorial staff of humorous paper. Address GEO. C. MASON, 14 Elm St., Hartford, Conn.

TRANSLATOR wanted to read German architectural works at sight (no writing). One familiar with technical terms desired. Address "A.," Box 149, New York Post Office.

Spraying Crops; Why, When, and How. By CLARENCE M. WEED. Illustrated. New York, Rural Publishing Company. 110p.

The author of this little book, formerly connected with the Ohio Agricultural Experiment Station, is now at the New Hampshire Station in the capacity of Entomologist. He has given in a condensed form an account of many insect and fungous foes of various fruits, trees, and vegetables. The information in regard to the former is much fuller than in regard to the latter, which is naturally to be expected from an entomologist. Quite full histories are given of the codling moth, the curculio, the canker worm, and the tent catterpillar. The only fungous disease treated with any degree of fulness is downy mildew or brown rot of grapes. The formulæ for the principal fungicides and insecticides are given, together with instructions how to combine the two. The few pages devoted to spraying are scarcely adequate to give a beginner an idea of what to do or how to go to work to do it; and in this respect the book is incomplete. Among the plants whose insect and fungous enemies are discussed we find the apple, peach, pear, plum, cherry, strawberry, currant, gooseberry, grape, raspberry, rose, potato, cabbage, and others. Some of the worst fungous diseases are not mentioned, such as oat and wheat smut, apple rust, peach yellows, pear and apple blight, etc. It cannot, however, be expected that in so small a book everything could be mentioned and described. It is, too, not improbable, that as these diseases cannot be prevented by spraying, that they are omitted intentionally. On the whole the book is one which will prove useful to the general fruit grower. JOSEPH F. JAMES.

D. C. HEATH & CO. have in press, and will soon issue "Elements of Plane and Spherical Trigonometry" and "A Treatise on Plane and Spherical Trigonometry," by Edward A. Bowser, Professor of Mathematics and Engineering in Rutgers College. The former is a brief course in the elements of trigonometry, particular attention being given to the numerical solution of plane and spherical triangles. It is prepared especially for high schools and academies. The latter is for more advanced work and covers the entire course in higher institutions. The books abound in numerous and practical examples, the aim being to make the subject as interesting and attractive as possible to the student.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

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Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
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SCIENCE

NEW YORK, AUGUST 5, 1892.

ON THE FUNDAMENTAL HYPOTHESES OF ABSTRACT DYNAMICS.[1]

BY PROFESSOR J. G. MACGREGOR, D.SC.

THE formally recognized axioms of abstract dynamics employed by most writers are the three Laws of Motion enunciated by Newton in the "Principia," not always in the form given them by Newton, but in some form or other. It is obviously important that such axioms should be precise in their enunciation, independent of one another, sufficient for the deduction of all propositions applicable to natural forces generally, and as few as possible.

These axioms are sometimes regarded as constituting a definition[2] of force. As defining force, however, they are not consistent with one another; for momentum being a relative conception, i.e., having magnitude and direction which vary with the point by reference to which velocity is specified, force, if defined by the first and second laws, must also be a relative conception. And it follows that the third law cannot in general hold; for it is easy to show that if it hold for one point of reference, it cannot hold for another having an acceleration relative to the first.

The axioms are thus statements about the action of force, force being assumed to be already a familiar conception. As applicable to the translation of bodies, they may be regarded either as hypotheses verified by the deductions made from them, or as generalizations established by direct though rough experiments. When, however, we come to study the effect of force in changing the rotation of bodies or their state of strain, we assume the laws of motion to hold for the small parts (particles or elements) of which we imagine the bodies to consist. And therefore, as forming the basis of dynamics as a whole, they must be regarded as hypotheses. In either case it is necessary to note that both the popular and the scientific conceptions of force ascribe to it a magnitude and direction quite independent of the point of reference which may be used in specifying the motion of the body on which it acts.

1. The Precision of the Laws of Motion.

Owing to this non-relative character of force, it is obvious that the first and second laws of motion can hold only provided the motion of bodies be specified relatively to certain points. In omitting the mention of these points, Newton's laws are somewhat lacking in precision; and it is important to determine what the points are.

As, according to the first law, two particles which are both free from the action of force must have uniform velocities, relatively to the unspecified point of reference, each must have a uniform velocity relatively to the other. Hence the first law, as pointed out by Tait,[3] holds relatively to any particle on which no forces act.

As, according to the second law, the acceleration of either a particle of finite mass acted upon by no force, or a particle of infinite mass acted upon by no infinite force, must be zero relatively to the unspecified point of reference, this law must hold relatively to all such particles.

But such particles are fictitious. To bring the second law within the region of practical application, we must find accessible points by reference to which it holds. This may readily be done; for it is easy to prove it to hold for a particle acted upon by given forces, relatively to any other particle, with respect to which, but for the action of these forces, the former would have no acceleration. Thus, as is usually assumed, the acceleration, relative to a point of the earth's surface, of a body situated at that point and at rest or in uniform motion relatively to it, except in so far as its motion may be modified by given forces, may be determined by the application of the second law.

It is interesting to note that this was the point of reference employed by Newton in the experiments made by him to verify the third law. In these well-known experiments[4] on the impact of spheres, the spheres were suspended by strings, and impact was made to occur when the spheres occupied their lowest positions. Their velocities before and after impact were taken to be proportional to the chords of the arcs (corrected for resistance of air), through which they had fallen, or were found to rise respectively. Hence the acceleration of a freely falling body was assumed to be vertical; and the point of reference was consequently the point of the earth's surface at which the experiments were made. Also at the instant of impact, the spheres were passing through their positions of zero acceleration relatively to this point. Hence the equal and opposite changes of momentum observed were specified by reference to a point with respect to which, apart from the action of the stress due to impact, the impinging spheres had no acceleration.

As the third law asserts merely the equality and opposition of two forces, it must hold for all points of reference; or rather it is independent of points of reference.

It follows that besides the points mentioned above, with respect to which the second law holds, there is, in the case of a system of particles, free from the action of external force, another, viz., the centre of mass of the system. For this point may be shown by the aid of the third law to have no acceleration relatively to any point, by reference to which the second law holds.

It may easily be proved that the stress between two particles is proportional to the product, by the sum of their masses into their relative acceleration; and that consequently, if one of the particles be of infinite mass, the stress is proportional to the mass of the other multiplied by the relative acceleration. Hence if, in applying the second law of motion, a particle of infinite mass be chosen as point of reference, all the forces acting on a system of particles, both external and internal, may be regarded as exerted upon them by the particle of infinite mass.

[1] Abstract of the presidential address to the Mathematical and Physical Section of the Royal Society of Canada, at the meeting held May, 1892.

[2] Maxwell's Matter and Motion, Art. XL.

[3] Properties of Matter (1885), p. 92.

[4] Principia: Scholium to Axiomata.

2. Independence of the Laws of Motion.

Maxwell[1] maintains that "the denial of Newton's first law is in contradiction to the only system of consistent doctrine about space and time which the human mind has been able to form." If this be so, it must be possible to deduce the law from the doctrine of space and time, and it cannot be held to be hypothetical in character. Maxwell's argument is as follows: "If the velocity [of a body freed from the action of force] does not remain constant, let us suppose it to vary. The change of velocity must have a definite direction and magnitude. By the maxim that the same causes will always produce the same effects, this variation must be the same, whatever be the time or place of the experiment. The direction of the change of motion must therefore be determined either by the direction of the motion itself or by some direction fixed in the body. Let us, in the first place, suppose the law to be that the velocity diminishes at a certain rate. . . . The velocity referred to in this hypothetical law can only be the velocity referred to a point absolutely at rest. For if it is a relative velocity, its direction as well as its magnitude depends on the velocity of the point of reference. . . . Hence the hypothetical law is without meaning unless we admit the possibility of defining absolute rest and absolute velocity."

This argument, which is endorsed by Tait,[2] may be used to prove Newton's law also to be without meaning. For this purpose all that is necessary is to substitute *displacement* for *velocity* or *motion*, wherever these words occur in the above quotation, and *changes* for *diminishes*. The argument is thus transformed into one equally good or bad, in favor of the cessation of motion on the cessation of the action of force, as against Newton's law.

The fallacy — for the argument would thus appear to be fallacious — seems to lie in the incomplete recognition of the relativity of the law of motion under consideration. Thus, when, in the second sentence of the above quotation, Maxwell says: "The change of velocity must have a definite magnitude and direction," he forgets that its magnitude and direction must vary with the point of reference. And the whole argument turns upon this asserted definiteness.

While the first law must be considered incapable of deduction, its right to formal enunciation among the fundamental hypotheses of dynamics has often been disputed on the ground of its being a particular case of the second law. This must be admitted; and its separate enunciation must therefore be pronounced illogical.

There is one objection, however, which may perhaps be urged against the omission of the first law, viz., that Maxwell[3] and other authorities hold that this law, "by stating under what circumstances the velocity of a moving body remains constant, supplies us with a method of defining equal intervals" of time. As no such statement is ever made about the second law, it would thus appear that the omission of the first would leave us without a basis for the measurement of time.

This objection, however, is easily met. For, first, the second law supplies us with more methods of defining equal intervals of time than the first law. In addition to the definition given by the latter, it tells us, for example, that those intervals are equal in which a body acted upon by a constant force undergoes equal changes of velocity.

[1] Matter and Motion, Art. XLI.

[2] Ency. Brit., 9th Ed., Art. Mechanics, § 298.

[3] *Matter and Motion, Art. XLIII*

Second, both laws assume that equal intervals of time have already been defined. So far as power of defining is concerned, therefore, they give us nothing that we did not possess before their enunciation. The only advance in time-measurement which we owe them is that they show us how to construct time-pieces which will mark off for us the intervals assumed to be equal in their enunciation.

Third, the intervals assumed equal in the enunciation of these laws are not known to be equal. What they assume is therefore nothing more than a conventional time-scale; and what they give us is nothing more than certain methods of securing accurate copies of this scale.

And, fourth, both of these laws may be enunciated so as to retain all their dynamical significance, and yet make no reference to the measurement of time, by adopting as the definition of velocity not distance traversed per unit of time, but the distance traversed while the earth (or, better, a certain ideal earth) rotates through a certain angle relatively to the fixed stars. Enunciated in this way these laws assume no definition of equal intervals of time, and can consequently supply us with no such definitions.

Newton's second law asserts that the acceleration produced in a body by a force is directly proportional to the force and has the same direction; and as the assertion is without restriction, the law implies that the effect of the force is the same, whatever the motion of the body may be and whatever other forces may be acting upon it. Many writers regard the latter implied part of the law as being the only hypothetical part. They therefore make it the second law of motion and attempt to deduce the former part from it, the argument being that since any number n of equal and codirectional forces will produce in a body an acceleration n times as great as that produced by one, the acceleration produced in a body must be proportional to the force producing it. It is here assumed, however, that n equal forces in the same direction are equivalent to a single force of n times the magnitude. Thus the explicitly asserted portion of Newton's second law cannot be deduced from the implied portion except by the aid of an additional hypothesis; and the law as a whole must therefore be regarded as hypothetical.

The third law is supposed to have been deduced from the first by Newton himself. Maxwell[4] appears to hold this view; Lodge[5] declares his adhesion to it; and Tait[6] says the third law "is very closely connected with the first." Newton's discussion[7] of the third law, in which he is supposed to make this deduction, consists of two parts. He first shows by the experiments referred to above, that the law applies to the case of the stresses between bodies pressing against one another; and he then extends it by the aid of the first law to gravitational stresses, and by the aid of further experiment to magnetic stresses as well. In this extension he does not say that he is building upon the results of his experiments on impact, but it seems obvious that he does so. Maxwell summarizes his argument admirably in the following words: "If the attraction of any part of the earth, say, a mountain, upon the remainder of the earth, were greater or less than that of the remainder of the earth upon the mountain, there would be a residual force acting upon the system of the earth and the mountain as a whole, which

[4] Matter and Motion, Art. LVIII.

[5] Elementary Mechanics (1885), p. 56.

[6] Properties of Matter (1885), p. 163.

[7] Principia: Scholium to Axiomata.

would cause it to move off with an ever-increasing velocity through infinite space. This is contrary to the first law of motion, which asserts that a body does not change its state of motion unless acted upon by external force." That this argument is based upon the assumption of the equality of the action and reaction between bodies pressing against one another, seems to follow from the consideration that otherwise the "residual force," due to the possible inequality of the action and reaction of the gravitational stress between the mountain and the remainder of the earth, might be regarded as neutralized by an opposite inequality in the action and reaction of the stress at their surface of contact. Even, therefore, if Newton's extension of his experimental result to forces acting at a distance were regarded as valid, the third law could not be regarded as deduced from the first. It would only be shown to be but partially hypothetical. But since, in the present state of dynamics, the laws of motion must be regarded as applicable to particles, Newton's argument, though valid when they were considered applicable to extended bodies, can no longer be admitted; for the uniformity of the motion of a body free from the action of external force is itself a deduction, which can be made only by assuming the third law in its most general form.

3. Sufficiency of the Laws of Motion.

The best test of the sufficiency of the laws of motion is the question, Can they give by deduction the greatest of all physical laws, the conservation of energy? This law may be proved, by the aid of the second and third laws of motion, to hold in the case of any system of particles which is neither giving energy to, nor receiving energy from, external bodies, provided the stresses between the particles act in the lines joining them and are functions of their distances. It has also been proved by experiment to hold in a very large number of cases in which the laws of the forces acting are unknown, the energy disappearing in one form and the energy appearing simultaneously in another form being measured. The amount of such experimental evidence is so large that no doubt is now entertained that the law of the conservation of energy is applicable to all natural forces. Hence the fundamental hypotheses of dynamics should either include this law or give it by deduction.

Although many writers state that this law may be deduced from the laws of motion, Lodge[1] is the only one, so far as I am aware, who claims to make the deduction. This he does in a passage beginning as follows: "All this, indeed, in a much more complete and accurate form — more complete because it involves the *non destruction* of energy, as well as its non-creation — follows from Newton's third law of motion, provided we make the assumptions (justified by experiment)," etc. It is unnecessary to quote farther; for when assumptions justified by experiment are called in to the aid of the third law, additional fundamental hypotheses are thereby selected.

The second law of motion enables us to take the first step in the deduction of the conservation of energy. The proof is so well known that I may simply cite that given by Thomson and Tait,[2] resulting in the familiar equation: —

$$\Sigma (X \dot{x} + Y \dot{y} + Z \dot{z}) = \Sigma m (\ddot{x} \dot{x} + \ddot{y} \dot{y} + \ddot{z} \dot{z}),$$

in which the first member represents the rate at which work is being done by the forces acting on the particles of a system, and the second is equal to the rate at which the kinetic energy of the system is being increased. It is usually called the equation of *vis viva*, and, having been deduced from the second law of motion alone, is applicable to all forces, whether conservative or not.

Newton gave this result in the Scholium to the Laws of Motion in a statement which may be paraphrased thus: Work done on any system of bodies has its equivalent in work done against friction, molecular forces, or gravity, together with that done in overcoming the resistance to acceleration. Thompson and Tait point out expressly[3] that this statement of Newton's, which, owing to the form he gave it, is often referred to as his second interpretation of the third law of motion, is equivalent to the equation given above. Nevertheless, it has been interpreted as being little less than an enunciation of the law of the conservation of energy itself.[4] Thus Tait[5] says it "has been shown to require comparatively little addition to make it a complete enunciation of the conservation of energy;" and "What Newton really wanted was to know what becomes of work which is spent in friction." Besant[6] takes the same view.[7] These writers seem to claim that Newton's statement is equivalent to what Thomson and Tait call "the law of energy in abstract dynamics," viz., "The whole work done in any time on any limited material system by applied forces is equal to the whole effect in the forms of potential and kinetic energy produced in the system, together with the work lost in friction." Of this it may certainly be said that what it wants to make it a complete enunciation of the conservation of energy is a statement as to what becomes of the work spent in friction.

Compare this, however, with Newton's statement, as paraphrased above, and it is at once obvious that what the latter wants to make it a complete enunciation of the conservation of energy, is a statement as to what becomes not only of work spent in friction, but also of work done against molecular forces and gravity, and of work done in overcoming the resistance to acceleration. Newton may possibly have known all this, but he does not say so; and we must therefore hold his statement to be, as Thomson and Tait point out, merely a verbal expression of the equation given above. The question of the interpretation of Newton's statement is of more than mere historical interest; for if it would bear the interpretations which have been put upon it, the law of the conservation of energy would be capable of being deduced from the second law of motion alone.

To pass from the equation of *vis viva* to the law of the conservation of energy, we require to know that the work done during any change of configuration of a system of particles acted upon by natural forces depends only upon the changes in the positions of the particles, and not upon the paths by which or the velocities with which they have moved from the old positions to the new. Helmholtz[8] showed that this deduction may be "based on either of two maxims, either on the maxim that it is not possible by any

[1] Elementary Mechanics (1885), p. 82.

[2] Treatise on Nat. Phil. (1879), Vol. I., Part 1, p. 269.

[3] Treatise on Nat. Phil. (1879), Vol. I., Part 1, p. 270.

[4] This address was written before I had seen Professor W. W. Johnson's paper on "The Mechanical Axioms, or Laws of Motion" (Bull. N. Y. Math. Soc., Vol. I., No. 6, March, 1892).

[5] Properties of Matter (1885), p. 104, and Recent Advances in Physical Science (1876), p. 38.

[6] Dynamics (1885), p. 49.

[7] Garrett (Elementary Dynamics, 1886, p. 47) goes so far as to say that Newton's statement "is nothing more nor less than the enunciation of the great principle of the conservation of energy."

[8] On the Conservation of Force (1847): Taylor's Scientific Memoirs. Nat. Phil. (1853), p. 114.

combination whatever of natural bodies to derive an unlimited amount of mechanical force [energy], or on the assumption that all actions in nature can be ultimately referred to attractive or repulsive forces, the intensity of which depends solely upon the distances between the points by which the forces are exerted." He showed also that it was immaterial which of these maxims was assumed, as the other could be at once obtained from it. How by the aid of either of these hypotheses we pass from the equation given above to the law of the conservation of energy is of course well known. The point to which it seems necessary to draw attention is that some hypothesis is required, and that either of these is sufficient for the purpose.

As the second of Helmholtz's maxims is simply an extension of the third law of motion, and as Newton's three laws have obtained such wide usage, it would seem to be desirable to adopt the second maxim as a fourth law of motion. Were we to select the first maxim, it would be necessary to re-cast our fundamental hypotheses altogether.[1] Possibly it might be advantageous to take this course, to make, as Tait[2] suggests, the laws of the conservation and the transformation of energy our fundamental hypotheses, and to banish the conception of force to the limbo of once useful things. But if Newton's laws are to be retained, they should be supplemented by the second of Helmholtz's assumptions.

It is at once obvious that this fourth law will, like the third, be independent of points of reference; and it follows that the law of the conservation of energy will hold relatively to all points by reference to which the second law holds. This conclusion is inconsistent with Newcomb's assertion[3] that this law "assumes that we refer the motions of all the bodies whose energy is considered to some foreign body of infinite mass, from which emanate the forces which give motion to the system." According to the above, this law may of course be expressed relatively to a particle of infinite mass, and, if thus expressed, the forces which give motion to the system may be supposed to emanate from that particle. But it may also be expressed relatively either to a particle of finite mass free from the action of force, or to the centre of mass of the system itself whose energy is conserved.

4. Reduction of the Laws of Motion.

Finally, the four laws of motion may obviously be reduced to two. The first has already been seen to be a particular case of the second. The third is involved in the fourth; for when it is asserted that natural forces are attractions or repulsions, it is implied that their action and reaction are in opposite directions, and when it is asserted that they may be expressed as functions of the distances of the particles between which they act, it is implied that their action and reaction are equal. The four laws thus reduce to two, which may be enunciated somewhat as follows:—

The Law of Force. — Relatively to any particle free from the action of force, the acceleration produced in another particle by a force is proportional to the force and has the same direction.

The Law of Stress. — Natural forces may be considered to be attractions or repulsions whose magnitudes vary solely with the distances of the particles between which they act.

[1] Many writers illogically select the first maxim as a fourth law. See Professor Johnson's paper cited above; also my Kinematics and Dynamics, § 436.

[2] Ency. Brit., 9th Ed., Art. Mechanics, § 291.

[3] Phil. Mag., Ser. 5, Vol xxvii. (1889), p. 116.

THE GREAT LAKE BASINS.

BY P. J. FARNSWORTH.

THE problem of the origin of the Great Lakes has for a long time engaged the attention of the scientists, who have come to a variety of conclusions, none of them very satisfactory. Subsidence, ice action, glacial scooping, and President Chamberlin's theory that they were hollows made by accumulating ice bending down the earth's crust.

An article in *Science* of June 3 presents a more plausible theory, that they are vallies of erosion, made by some great river, giving as evidence the map of Dr. Spencer, pointing out the discoveries and probable deep pre-glacial channels leading into the St. Lawrence and the Atlantic. Professor Spencer, in his paper on High Continental Elevations, read at the Scientific Association at Toronto, 1889, sums up by saying, "The lake basins are merely closed-up portions of the ancient St. Lawrence valley and its tributaries." "The lake basins are all excavated out of Palæozoic rocks except a part of that of Lake Superior."

If we go back in geologic history to Azoic times we find that the first emergence of the continent was the V-shaped land around Hudson's Bay, an open sea below it. Next, an emergence of a point below the V and a line of height extending along the lower side of what we call the river and gulf of St. Lawrence. A sea or strait extended round the primitive land from the Atlantic to the Arctic Ocean on the north-west. After the elevation of the trough at the north-west, an inland sea was left covering Superior, Michigan, Huron, and Ontario, leading into the St. Lawrence Gulf. In time there was elevation and subsidence and flexion of strata, as pointed out by Professor Spencer, and the great basins were left as interior seas. There was a large watershed to the north that compelled an overflow, that made its way in the deep channels that have been discovered, at some time out of Ontario, across New York, then, if there was continental elevation, making the deep channels down the valley of the St. Lawrence and far out into the Gulf. Lake Champlain was a pool in a fissure of the Azoac world, that was connected with the open channel in the Archean land.

The ice period so obstructed the old outlet that when it was melting, the superfluous waters of the great basins were poured into the Gulf of Mexico through the Illinois and Wabash rivers. When the ice disappeared, the old outlet had become obstructed by flexions of strata and mountains of drift. It is evident that Lake Michigan had a channel through Georgian Bay, and thence into Ontario. It is not yet apparent where the deep channel for the waters of Superior came in, or that it had any such. It has an insignificant but sufficient outlet through the St. Mary's River. Michigan and Huron reach Ontario over the St. Clair flats and through the shallow trough that holds Lake Erie, which probably is of post-glacial age, and then into Ontario down the hill that is being cut back by the falls of Niagara.

The great lakes were deep seas before the world was cold enough for ice, and were great basins before glaciers were possible.

One could hardly conceive how glacial ploughing coming from the north or north-east could make chasms at such angles to each other. In regard to cut of channels of erosion, it would require a river from the south-west and north-west, from Michigan and Superior, of such maguitude that great valleys or traces of them would be left. Lake Superior is 360 miles long and 150 miles wide in some places, with a

depth of 1000 feet, with a probable 100 or 200 feet more covered with sediment 600 feet above tide-water, which would make its bottom 500 feet below sea-level. To conceive it as an old river channel would require an elevation of the continent of 1500 feet above its present level. It is, moreover, surrounded by high rocky shores having few rivers coming into it, as its watershed was never large and not channeled by fjords.

There may have been an elevation of the continent, but the lakes went up with it; there was undoubtedly ice but the lakes were there before it. They are pools left by the old Azoic Sea.

Clinton, Iowa.

NOTES AND NEWS.

IN the latest quarterly statement of the Palestine Exploration Fund as we learn from *Nature*, it is said that considerable progress is being made with the Akka-Damascus Railway, the route of which, after various expensive surveys, has been definitely decided upon. The line chosen is practically that first suggested by Major Conder, R.E. several years ago. Beginning at the great fortress of Acre, the railway will run down the plain of Acre parallel with the sea, throwing out a branch to Haifa, at the northern foot of Mount Carmel, and thence to and across the plain of Esdraelon, passing near Nazareth to Shunem and Jezreel, and through the valley of Jezreel, skirting the slope of the hills, to the river Jordan, which will be crossed within sight of Bethshean. The Jordan here offers exceptional facilities for the erection of the railway bridge, consisting of two spans. Not only are the two opposite banks of the river formed of solid rock, but the centre of the river contains a large block of similar rock, from which each span of the bridge will be thrown to the east and west bank respectively. From the Jordan the railway will ascend the slope of the Jaulan Plateau, along the crests that close the eastern shores of the Sea of Galilee, this ascent constituting the only difficult portion of the line, but which the surveys now made show to be much easier of accomplishment than was originally anticipated. The plateau near El'Al being reached, an easy gradient will carry the line by Seil Nawa and Kesweh to Damascus. Passing through the finest plains of western and eastern Palestine, the railway will be one of great importance. The authorities of the Palestine Exploration Fund are of opinion that its construction can hardly fail to lead to important archæological discoveries, and the committee hope to make arrangements for obtaining full information respecting these.

— The *Kew Bulletin* for May and June, according to *Nature*, contains several contributions which will be of great interest to botanists and to various classes connected with the industrial applications of botany. One of these contributions is a valuable report (with a plate) by Mr. George Massee on a disease that has attacked vanilla plants in Seychelles. In the same number are printed the second of the Decades Kewenses Plantarum Novarum in Herbario Horti Regii Conservatarum, and the second decade of new orchids. An excellent illustration of the way in which the authorities at Kew seek to promote industry is afforded by a correspondence on Sansevieria fibre from Somali-land. The increased attention devoted to the production of white rope fibres in the western tropics appears to have had a stimulating effect in the East Indies, and now the production of fibre from *Agave vivipara* in Bombay and Manila is followed by a fibre obtained from Somaliland from a singular species of Sansevieria. This fibre was first received in this country as an "Aloe" fibre. It was soon noticed, however, that it possessed characteristics differing from all ordinary "Aloe" fibre, and a request was made to the Foreign Office that Colonel Stace should be invited to obtain for the Royal Gardens a small sample of the fibre, a large leaf from the plant yielding it, and, if possible, a few small plants for growing in the Kew collection. In due time the specimens arrived in excellent order, and it was found that the fibre is one of the many so-called Bowstring Hemps, and probably yielded by *Sansevieria Ehrenbergii*, a plant first collected by Dr. Schweinfürth. Little or nothing was known of it until it was described by Mr. J. J. Baker, F.R.S., in the Journal of the Linnean Society, Vol. xiv., p. 549. Its locality is there stated as "between Athara and the Red Sea." The plant is described in a letter to the Foreign Office, written by Mr. D. Morris, as a very interesting one, and he adds that its existence as a source of a valuable supply of fibre will be sure to awaken attention among commercial men in Great Britain. Messrs. Ide and Christie, writing to Mr. Morris, speak of the fibre as an excellent one of fair length and with plenty of "life." "In character," they say, "it strongly resembles the best Sisal hemp, with which we should have classed it but for your statement that it is derived from Sansevieria. With the exception of its color, its preparation is perfect, and, even as it is, we value it to day at £25 per ton. We are of opinion that if care were taken to improve the color a considerably higher price would be readily attainable, perhaps as much as £50 per ton, if a pure white fibre could be attained without loss of strength and lustre."

— The Harvey process of case-hardening, which has been so successfully applied to giving a hard surface to armor plates, is carried out as follows, according to *Engineering:* The plate to be treated is made out of mild steel, containing, say, 0.10 per cent to 0.35 per cent carbon, and, after being formed to its final shape, is laid flatwise upon a bed of finely-powdered dry clay or sand, which is deposited upon the bottom of a fire brick cell or compartment erected within the heating chamber of a suitable furnace. The upper surface of the plate is then covered with powdered carbonaceous material, which is tightly packed. Above this is a layer of sand, and over the sand is laid a heavy covering of fire-bricks. The furnace is then lighted and raised to a temperature sufficient to melt cast-iron, and this heat is maintained for a greater or lesser period, according to the amount of carbonizing to be effected. About 120 hours are said to be required for a plate 10½ inches thick. On removal from the furnace such a plate is found to have had the composition of its upper surface changed. At a depth of about 3 inches from this surface the percentage of carbon has been raised by about 0.1 per cent, which increases progressively as the outer surface is neared, when the amount of carbon may rise to 1 per cent. It is said that this process, though, as will be seen, it resembles the ordinary cementation process, does not cause any blistering of the surface of the plate. This the inventor attributes to the high temperature at which it is carried out; but it is also suggested that the absence of blisters may be due to the homogeneity of the metal used, which, unlike the wrought-iron bars used in the cementation process, is free from cinders.

— An interesting addition to the much-vexed Sumero-Akkadian question has recently been made by an Ottoman scholar. Ohannes Sakissian Effendi, an official in the Treasury department at Constantinople, has issued privately the first instalment of a work intended to prove that the non-Semitic idiom of the cuneiform inscription is related linguistically to Armenian, Turkish, and ancient Egyptian. He strenuously combats the theory of the Rev. C. J. Ball, of the affinity of Akkadian and Chinese. That Akkadian or rather Sumerian was related to Turkish or to Armenian is by no means inherently improbable. We can hardly admit being convinced by the author as yet, and would prefer awaiting some ethnologic evidence before reaching a conclusion. But we cannot fail to welcome to the ranks of students of the ancient civilization of Mesopotamia the first subject of the Empire of which Mesopotamia is a part, who has busied himself with cuneiform studies. Turkey has produced investigators in all branches of modern science, a classical archæologist and explorer like Hamdi Bey, a Turkish lexicographer like the late Ahmed Vefik Pacha, or a man like Tewfik Bey Ebuzzia, the historian of Turkish literature, a writer on military matters like Djeva Pasha, the present Grand Vizier, or a student of pure mathematics like Tewfik Pasha, the present minister of public works. Sakissian Effendi is the first Ottoman who, to our knowledge, has written on a subject connected with cuneiform research, and we take the appearance of his brochure as an omen that these studies will be seriously taken up at the Imperial Museum in Constantinople. A catalogue of the cuneiform objects preserved in that museum would be eagerly welcomed by the learned world.

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THE HOPKINS SEASIDE LABORATORY.

BY DAVID S. JORDAN.

ONE of the best equipped and most favorably situated of the marine laboratories for research is the Hopkins Seaside Laboratory on Monterey Bay in California. This institution is an outgrowth from the biological departments of the Leland Stanford, Jun., University, its equipment having been provided for by the generosity of Mr. Timothy Hopkins, one of the trustees of the University. The laboratory is situated on a rocky point of land known as Point Aloha, which juts into Monterey Bay near the village of Pacific Grove. The laboratory is a two-story, frame building sixty feet by twenty. On each floor the many windows make the sides of the building virtually of glass. The lower floor is devoted to aquaria and to work in connection with aquaria. The upper floor is fitted up for advanced research, with private rooms for workers in special fields. On the lower floor are seven aquaria provided with running water, besides various glass jars and similar vessels used for the study of smaller animals.

The fauna of Monterey Bay is peculiarly rich, as the life histories of the animals of this region have been scarcely studied by zoologists. The laboratory, therefore, offers special attractions to naturalists, particularly to workers on tunicates, jelly fishes, star-fishes, fishes, and nudibranch mollusks. The material for zoological purposes is extremely abundant, and one singular feature of the life of this region is the immense size to which many animals grow as compared with the size reached by their relatives in the Atlantic.

In the aquaria I notice many specimens of salpa, large transparent tunicates, reaching a length of four or five inches. There are nudibranch mollusks (*Aplysia*) nearly a foot in length, and a twenty-armed star-fish (*Pycnopodia*) whose span covers the whole height of one side of the aquarium. This creature has been timed in making a circuit of the four sides of the aquarium, covering the distance of about nine feet in just four minutes. Immense jelly fishes which will almost fill a bushel basket are also very common, and sea anemones, reaching a size by which the largest of the Atlantic seem like marigolds compared with sunflowers. Tunicates, chitons, limpets, sea urchins, sea anemones, octopus, and squid exist in great abundance and variety. Among the fishes are also many forms of interest in the aquaria, numerous species of blennies and sculpins abounding about the rocks. The blue hag-fish (*Polistotrema*) occurs in great abundance. This is an eel-shaped fish about a foot to a foot and a half in length, which lives as a parasite in the bodies of other fishes. It enters at the eye or at the throat or some other soft place, and then by means of the rasp-like teeth, makes a hole in the body of its host and in time without breaking or disturbing the bones or viscera of the unfortunate animal, it will devour the entire muscular system of the fish on which it feeds. Many of the larger flounders and like fishes obtained in the Bay of Monterey are found to be half-devoured or reduced to mere hulks by the operation of this singular fish. The locality is especially favorable for the study of the viviparous surf-fishes and rock-fishes. The huge torpedo or cramp fish, which is found across the bay about Soquel, also invites investigation. As I write, a grampus 12 feet in length is brought in in a dray-wagon by a Portuguese fisherman from Monterey, while a constant stream of objects of interest comes in from the Chinese fishing camp at Point Alones. The marine flora of the Bay of Monterey is equally interesting. About one hundred and twenty species of sea weeds have been collected by Mr. Bradley M. Davis, who has charge of the work in botany. These range in size from the giant kelp, which here has a length of thirty or forty feet, down to the minute algæ about the wharves.

The laboratory is well supplied with collecting apparatus, with microscopes, reagents, embedding apparatus, and the usual material for study, this being brought from the laboratories of the Stanford University. About thirty students have been in attendance during the summer, some of these being advanced workers in different departments, some of them teachers and the others students from the laboratories of the university.

Among the pieces of special work which may be noticed are the studies of Professor Frank M. MacFarland on the egg segmentation of the nudibranchs, those of Frank M. Cramer on the nervous system of the limpet, those of Leaverett M. Loomis on the sea birds of Monterey Bay, those of Wilbur W. Thoburn on the rock-fishes, those of Miss Flora Hartley on the anatomy of the abalone, and those of Mr. Charles W. Green on hydroids.

The instruction for the summer has been in the hands of Professors Charles H. Gilbert and Oliver P. Jenkins, of the chairs of zoology and physiology respectively, in the Stanford University, assisted by Bradley M. Davis and Wilbur W. Thoburn, graduate students. The purposes of the laboratory as set forth in the circular are: To supplement the work given in the regular courses of instruction in the zoological, botanical, and physiological departments of the university under the favorable conditions of such a station; to provide facilities for investigators who are prepared to make researches in marine biology, for which the Pacific Coast offers exceptional attractions, in that its field is very rich and is as yet largely unworked, to afford an opportunity to those, especially to teachers, who desire to become acquainted with marine animals and plants, and to learn the practical methods of their study.

In respect to the abundance of material and newness and freshness of the fauna to be studied as well as in the matter

of comfort and convenience of living, there are none of the seaside laboratories which are so fortunately situated as the one at Pacific Grove.

The views from the windows of the laboratory are singularly picturesque and attractive. On the east is seen the long curve of Monterey Bay, bordered by white sand-dunes covered with deep green chapparal, the dark pine trees of Pacific Grove, and the rocky promontory of Point Alones with its Chinese fishing camp in the foreground, and in the distance the mountains which separate the valley of Monterey from that of San Benito. On the west the irregular coast-line is visible as far as the point of pines, and on the north the broad sweep of the bay-shore is in sight as far as the lighthouse of Santa Cruz. The Bay of Monterey, with its surroundings of rock, forest, and mountain, is one of the most picturesque in the world, and to the eye of the naturalist it has no equal, at least short of the coral-lined harbors of the tropics.

THE ANTENNÆ AND STING OF YIKILCAB AS COMPONENTS IN THE MAYA DAY-SIGNS.

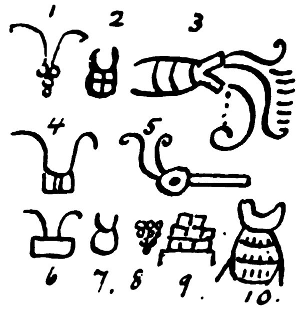
BY H. T. CRESSON, A.M., M.D.

BEE-CULTURE among the ancient Mayas seems to have received considerable attention, and the apiarists, we are told, had patrons, — the *Bacabs*, — one of whom, called *Hobnil*, was in especial favor. It was in the month Tzoz that the bee-keepers began to prepare themselves for their celebration in Tzec, and the four Chacs were at that time presented with plates of incense, one for each Chac, the borders of which were painted around with designs representing the honey-comb.

The species of bee which prepared the celebrated honey of Estabentûm, from a white flower resembling our jessamine, is like the common bee of Europe in shape and size, and differs from it only in having no sting; it is in fact the bee of Yucatan and Chiapas, and the honey which was prepared, especially during the month when the Estabentûm bloomed, was much sought after in early times, and no doubt formed an important article of commerce between the inhabitants of *Maiam* and the island that is now called Cuba. Four or five other species of bee are said to exist in Yucatan, but, with a few exceptions, their productions are inferior to the bee common to that country and Chiapas.

That the honey-bee was highly esteemed by the ancient Mayas there is but little doubt; for we see this industrious insect represented in various portions of the "Bee-Keeper's Narrative" of the Codex Troano, while honey in the comb is represented by the Maya scribe as square cakes of that material (see Fig. 9, plate), carried in the hand of the "god with the old man's face," — so named to distinguish him from other gods who were represented in the same narrative. Honey is represented by other hieroglyphs, one of which, shown in Fig. 8 of the drawing, has an especial connection with the antennæ sign, and we will presently refer to it. If our alphabet interprets with a reasonable degree of exactitude, we suppose the god with the old man's face to be Kukuitz, who appears in one of his various characters as the patron of the bee-keepers. The phonetic components of the hieroglyph which invariably accompanies this god, suggest this interpretation. In front of the glyph we have components of the day-signs Chuen and Akbal enclosed in the dotted aspirate circle, while below it are Landa's aspirates twice, and even in some cases thrice repeated. This gives us "chu-chu" or "khu-khu." Within the glyph, surrounding the eye, is the scroll which is always present in this god's glyph, and to us suggests the phonetic value of *ix* or *itz*. The c^hi glyph is generally placed underneath what we have assumed to be used as a determinative; the two round glyphs on either side of the tooth-like projections inside of the c^hi glyph suggest that in this case it is to be used as Chu. I find this c^hi glyph appearing as chá, chā, c^hi, cho, chu, a determinative being generally added to suggest which is to be used, whether it be á — ā — i — o — u. An example of one of these supposed determinatives will be given further on in this paper.

The sting of the bee is used in the day-sign *yk* or *ik* (see Fig. 7 of drawing), and appears quite frequently in glyph form in the Troano, also in Landa's day-signs and those of the Chilan Balaam of Káua, and is attached to the body of the *ahaulil-cab*, who so frequently appears in the Troano with body erect as if ready to strike with her stinging apparatus (Fig. 10 of drawing). It can readily be seen that this sting is but a variant of that used in the day-sign *ik* (Fig. 7 of drawing). It can also be seen attached to the right-hand side of the head-dress of the goddess *Cab*, second division of plate 25, Codex Troano. The end of the bee's abdomen and the stinging apparatus (Fig. 3 of drawing) is somewhat square like those of the Codex Troano (Bee-Keeper's Narra-



A.

tive); but it is easily recognized as a variant of glyphs 7 and 10 of our drawing. The determinative ending is placed just beyond the stinging apparatus, and is composed of the *i* loop and *kil;* the dotted aspirate also appears, and the *há* glyph is the parallel line running out from the *il* curve — "ish-kil-há" is thus expressed, an admirable suggestion of "*Ikilca*" (*b* is understood).

The antennæ of the bee appear in the day-sign Cauac; in fact the signs *yk* (or ik), *Cauac*, and *Caban*, all have the sting and antennæ of the bee as components. This connection will be more apparent by reference to Dr. D. G. Brinton's study of the "Books of Chilan Balaam," pages 16 and 17. The day-sign 13 Caban, in the Chilan Balaam of Káua, has the antennæ of the bee for its components, and 2 *Cauac* and 5th *ik* have the antennæ and sting, one more component appearing in 2d Cauac than in 5th *yk*. These same signs in the Landa and Troano columns of Brinton's plates have the honey signs, and the antennæ and hive, all used as phonetic components of the glyph, that of Landa and the Codex Troano rendering the word *ikilcab* with great simplicity. It is expressed thus, "x-il-cab," the dotted *sh*, or *x* aspirate, being added to assist the reader in obtaining the correct interpretation. The *Cauac* glyph also appears in the bas-relief of Kukuitz, the left-hand slab alongside of the doorway, Casa No. 3, Palenque. By placing a lens on a good photograph of this masterpiece of the scribe sculptor's art, the antennæ of the bee can be seen attached to the honey-sign (Fig. 1 of the drawing shows this glyph), the antennæ being at-

attached to the honey-sign. In the more demotic *Cauac* glyphs honey is represented as shown in Fig 8 Erosion has partially destroyed one of the components of the Casa No. 3 Cauac glyph of which we speak, but by comparing the photograph with Catherwood's drawing, it will be found to closely resemble this component in the demotic *Cauac* glyph. It is simply the aspirate circle (dotted), enclosing two small squares as in the Landa glyph of Cauac. In this connection it may be interesting to add that an attempt to interpret, by means of our alphabet, the inscription at the top of the left-hand slab, Casa No. 3, Palenque, gives as follows: "The gods — earth — sky — water — maize — Kukuitz and Kukulcan — Cauac — Muluc." The slab at the right-hand side of the doorway of Casa No. 3 we think represents *Kukulcan* with the wart-like excrescence and the antennæ sign attached to his forehead. The inscription, according to the rendering of our alphabet, reads "Kukulcan, u-ahkin imix, ah-Cimil, Chikin." The forefinger of the left hand of Kukuitz on the left-hand slab of Casa No. 3, Palenque, points to a glyph just above, which is probably the hieratic glyph of this god, bearing, we think, strong affinities to the demotic character, an attempt at the analysis of which has already been given in this paper. Just above the Kukuitz glyph, in the perpendicular column in front of the god's face, is *Chikin*, above Chikin is *Ahau*, the next two glyphs not yet determined, and then immediately below the horizontal line of glyphs in the right-hand corner of the slab is *Cimi*. Just above *Cimi* is *Kan*, and to the left *Ikilcab;* the third to the left on this parallel line of glyphs seems to be the long-nosed god — probably *Kukulcan* — next to it *Itzamna*, and the end glyph on the left seems to express "Itza." This interpretation is made subject to further alteration and improvement; to give detailed analyses of these glyphs in a short paper is impossible.

The small figure on Plate 25 of the Codex Troano (*b*), turned head downward, shown in drawing B, has some interesting relations with the antennæ glyph attached to the honey-sign (see Figs 1, 4–6, drawing A — 1 and 6 = hieratic script, 4 = demotic). The drawing B is but a portion of the original design of the scribe, the hand supporting the antennæ sign, enclosed in the circular glyph underneath the upturned foot, is that of the goddess *Cab*, or the earth. Just above the antennæ glyph (phonetic value = i-kil-cab) is the foot which = *uoc*. The hand of the goddess supporting this design is the c[h]i glyph, but in this place it has the phonetic value of *Chá*, the *há* determinative being quite conspicuous on the thumb, its end protruding well into the circle enclosing the antennæ glyph. This obtained, we have suggested "chá-uoc" or *Cauac*.

The *ca* glyph in the eye of the child figure and the foot also give us, *cauoc* a repetition of *cauac*. The antennæ of the bee with the slight *i* curve at the end give the phonetic value *ikil*, and the honey squares below give us *cab* = *ikilcab*. There is evidently some close connection between *cauac* and *ikilcab*, for the head-dress of this child figure has the scribe's method of representing honey by squares and suggestions of *ikil*. The work of the scribe sculptor was necessarily different from that of his more demotic brethren, who drew the more cursive script, yet there seems to us to be a not improbable relationship of this figure on Plate 25 of the Troano to that upheld in the arms of the *ahkin* on the Casa No. 2 group — Palenque. The peculiar slit or deformed feet and variants of the head-dress suggest that future study may show some connection between these figures, and that *ikilcab* and *cauac* may have a dual meaning or personality. Mr. W. Thomson, who has been residing in Chiapas for many years, informs me that during a visit to Lorillard City his Maya servant, who had been a bee hunter in his youth, accompanied him, and while they were preparing a resting-place for the night the cry of a jaguar was heard; the old man shook his head, and laying his hand on a sculptured lintel near the door of the temple, said rapidly "The jaguar calls, the bee leaves the centre of the maize flower and seeks the hollow tree," then turning toward the bas-relief he indicated the head covering of the figures ejaculating "*cab*," then as if startled at what he had said, he relapsed into silence, and no amount of questioning could obtain anything further from him. I cannot recall where I have read it in one of Dr. Brinton's books, but he mentions that Dr. Berendt while travelling with a Maya guide overheard some remark which he made having an interesting meaning, but the man, recollecting that he was accompanied by one of the white race, stopped short in his words and nothing further could be elicited from him. The suggestion of *cab*, a hive, was an excellent one, for the head coverings of these

B.

figures, as represented by Charnay on page 391 of his "Villes du Nouveau Monde," seem to be representations of bee hives; and it was the antennæ sign to the right-hand side of the large figure on this slab, or lintel, that led my learned friend to make the suggestien that the antennæ, attached to the sign for honey, might possibly exist on other sculptured Maya reliefs. As I have stated, it exists in the manuscript Troano (see Plates 24 and 25), and a sculptured slab in the Smithsonian Institution has it represented by an incised square, to which the antennæ are attached (see *A*, Fig. 6). It is the most demotic form of the hieratic-scribe-sculptor's work that I have examined. The glyph in question is to be seen on a cast which is now hanging on the stairway-wall of the Smithsonian Institution at Washington, to the right-hand side of the long gallery in which Professor Thomas Wilson has arranged his interesting synoptical cases. No record is attached to the cast, but by its character and technique it seems to be a copy of one of Charnay's squeezes, probably from Lorillard City. The antennæ glyph frequently appears near representations of corn leaves, and as we have the day-signs *Ixim* and *ik*, the latter, there is but little doubt, being but an abbreviation of *ikil* = the sting

(the sign used for this day is the bee sting), there is evidently a connection between *ymix*, *ik*, *caban*, and *cauac*, whose components are all more or less associated with, or composed of, the bee and honey signs.

When I speak of the components of a glyph it may be that an example will make this more readily understood. Take the day-sign *manik*. We have in this glyph, as represented by Landa, four components; the first is the glyph not unlike a carpenter's T-square which has the phonetic value of *ma;* near it to the right are three short lines which $= n$; and below to the left is the *ich* or *ix* glyph, which gives us, together with the others, "Ma-n-ich" — an excellent suggestion of Manik. The day-sign, *chicchan*, was represented by a pot, the base of which was crossed by hatchings giving the phonetic value *x;* the white space at the end of this divides the hatching from a black line, to which tooth-like processes are attached, giving the phonetic value of "*há-ch.*" We now have *x* or *sh*, which, joined to *há*, $=$ *xá;* placing *ch* before this we obtain "*ch-xa*" — the suggestion of "Chi-xa" or "chicchan." The hieroglyph of the day-sign *Ahau* contains as components the á glyph, from which perpendicular lines mount to the top of the circle enclosing them. The straight lines $=$ *há*, and the two small round circles on either side of the há $=$ oo, giving us "Ah-há-oo" or "Ahau." The phonetic components of Landa's B are simply expressed by conventionalized footmarks $=$ *be* in Maya; and when Landa asked for *bay* (the way he pronounced it in Spanish), the Maya scribe jotted down representations of footprints which recalled to him the sound of the name of the thing represented — in other words *be* — pronounced bā in Maya.

I believe the standard of phoneticism in these old Maya glyphs to be about the same as the more advanced system of writing used by the Nahuatalacs, and described by M. Aubin. The phonetics of some of the Maya day signs are quite obscure, others quite clear and easily interpreted.

The scientific world is already coznizant of the painstaking labors of Professor Cyrus W. Thomas of the Bureau of Ethnology, and his researches upon the Codex Troano are of inestimable value. I have recently had the pleasure of working in conjunction with Dr. Thomas as a member of the staff of the above-named institution, and I am convinced that his alphabet is based upon a solid foundation. Although we are both working by independent methods of research, like results have been obtained in several cases by repeated tests. His recent publication in *Science* adds other similarities of interpretation; surely this correspondence of results cannot be the result of accident. Dr. D. G. Brinton, Professor of American linguistics and archæology in the University of Pennsylvania, in a recent letter, says, "The correspondence between your interpretations and that of Professor Thomas in certain cases is strong *prima facie* evidence that both methods are based on correct principles." I have but to repeat Dr. Thomas's words "that this agreement in our conclusions . . . serves to strengthen both in the conviction that we are making genuine progress in the solution of this difficult problem."

"THE Optics of Photography and Photographic Lenses," by J. Traill Taylor, editor of the *British Journal of Photography*, is a useful little volume for those who desire to master the optical principles involved in the construction of photographic lenses. The work is also of value to the practical photographer, as it gives directions for the proper use of diaphragms, for the testing of lenses, etc.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The English Sparrow and Other Birds.

I HAVE often read accounts of the English sparrow driving out our native birds, and for several years have been watching closely to see what the truth is; and from my observations I must conclude that many persons write facts from imagination.

That matters may be better understood, I may state that for twenty-three years I have lived on Ohio Street, the principal business street of the city, between 9th and 10th streets; this being near the centre of the city, the business buildings extending on Ohio Street half-way between 7th and 8th streets, and the residences having considerable ground around them, with many shade trees from fifteen to twenty-five years old.

The English sparrow came to Sedalia about twelve years ago, and for a long time did not get away from the vicinity of the business centre. Some five or six years ago, during a severe winter, I saw them one time only as far out on Ohio Street as Broadway or 8th Street, to which point they had come hunting something to eat on the street. The following summer they were frequently seen on the block between Broadway and 9th Street, but came into my yard only a few times. The following summer they were frequently in the yard, but made no nests. Since that time they have built their nests in the yard, and have fed in large numbers in the chicken-yard.

The trees are now large enough and dense enough to furnish protection for birds, and of late years more kinds are found in the city than formerly. The blue jay stays the year round, and during the winter as well as summer the red bird and some other kinds are frequently seen. In summer the tree black bird, the robin, the cat bird, the rain crow, or cuckoo, and the wren are abundant, and make their nests. In addition to these, the brown thrush, the mocking bird, the red-head woodpecker, the red-head flicker, the sap-sucker, and other kinds are often seen, some of them daily.

Now, which of all these birds has been affected by the sparrow? Not a single one of them. They are all as abundant as they were five years ago, or at any time in the past, and much more so than they were ten to twenty years ago, before there were as many trees as there are now.

In addition to the birds mentioned, I might name three others. The town martin has always been in the city in great numbers, making their nests in all kinds of cavities around the houses in the business part of the city. These same places were taken possession of by the sparrows; and they being here the year round, and making nests even in the winter time, the places belonging to the martins were appropriated before their arrival, and when they came they had to fight to recover them. I was much interested in watching one of these fights. Across the roof of a one-story building next to my office, and in the top of the adjoining building, a martin had found a hole, and had appropriated a place within for a nest. A sparrow had also afterwards done the same, and was found in possession when the martin arrived from its winter pilgrimage. The latter at once gave fight, and time and again during their fight they would fall to the roof below, and were so intently engaged that more than once I had my hand almost upon them before they would let go of each other. The martin won the fight, and the sparrow gave up the nest it had taken.

As I now sit in my yard the martins are circling overhead by the hundred, they staying during the day in the business part of the city. It is very evident that the sparrows have not run the martins out, although they are direct competitors for the same nesting places.

Years ago the chippee always made its nests in my yard, but has not done so for six years, except in one case, and that nest was abandoned without being completed. I do not know the reason; I imagine the English sparrow domineers over the little

chipping sparrow, but still the latter quit nesting in my yard before the former commenced.

I put up boxes which were formerly occupied by bluebirds. As soon as the sparrows nested in my yard they took possession of those boxes; and when the blue birds came they did not have the grit or strength to turn the intruders out, and they went elsewhere to nest. After nesting time they are seldom seen in the city during the summer. Very clearly the sparrows have driven the blue birds out of this part of the city, and possibly the chippees; but if they have affected any other kinds, my obervation has not been keen enough to detect it, though I have had my attention directed to it for years. F. A. SAMPSON.

Sedalia, Mo., July 25.

On Maya Chronology.

IN a former communication, answering Professor Cyrus Thomas's "Brief Study of the Palenque Tablet," I stated that the theory brought forward by Professor Förstemann, that the Dresden Codex does not count the days from the first of the given month but from the last of the preceding month, is to be put aside. Professor Förstemann's theory is based on the supposition that the calendar system of the Dresden Codex was the same as that which prevailed in Yucatan at the time of Bishop Landa's writing. This supposition, however, is an erroneous one. In the "Zeitschrift für Ethnologie," Vol. XXIII., I have shown that the priests who wrote down the Dresden Codex did not begin their years with the signs *kan*, *muluc*, *ix*, *cauac*, as in Landa's time, but with the signs *been*, *e'tznab*, *akbal*, *lamat*, exactly corresponding to the signs used by the Mexicans to designate their respective years. Beginning the years in this manner, the day 4 *ahau*, 8 *cumku*, is really the eighth day of the month *cumku* in the *been* or "cane" years, and conformingly all the other dates throughout the whole Dresden Codex.

I wish to call attention to a passage of the Chilam Balam of Mani which seems to confirm my opinion. It is said there (Brinton, Maya Chronicles, p. 98): "In the Katun, 13 *Ahau*, Ahpula died. It was in the course of the sixth year before the ending of the katun, as the counting of the years was in the east, and (the year) 4 *Kan* seated upon the throne, on the 18th day of (the month) *Zip*, on the day 9 *Fruix*, Ahpula died." Now it occurs only when beginning the count with the first day of the month, that a day 9 *Fruix* is the 18th day of the month *Zip*. And, indeed, in the year that begins with the day 4 *Kan*, the day 9 *Fruix* is the 18th day of the month *Zip* — beginning the count with the first.

Here, therefore, we have the same designation of a date by the sign of the day and the position it holds in the number of twenty, or a Maya month, as in the Dresden Codex. It seems scarcely probable that the natural manner of counting seen in the passage of the Chilam Balam, quoted above, should be replaced in the Dresden Codex by another and wholly unintelligible one.

DR. ED. SELER.

Steglitz, July 24, 1892.

The Palenque Tablet.

ALLOW me to say in reply to Dr. Seler that I did not "follow Dr. Förstemann" in regard to the peculiar method of counting days in the Dresden Codex. I had discovered this peculiarity before I was aware that anyone else had noticed it, and have now an unpublished article on the series, — Pls. 46-50, — based on that method, which was prepared some time ago. While at work on this paper the thought occurred to me that the series might be based, as Dr. Seler supposes, on a calendar in which the years commenced with *Been*, *Ezanab*, *Akbal*, *and Lamat*, and a table was prepared on this theory.

I quote from that paper my reply to the suggestion. After noting the fact that the count began with the last day of the month, I remark, "It might be argued from this that the years and months began with what have been considered the last days, but for the fact that all the historical evidence is against such a conclusion, and, as can be shown, a full and complete explanation of this series can be given without resorting to this theory."

There are also some difficulties in the way of this theory. Pushing back the series one day is a very simple process; but it will sometimes throw dates in the five added days which do not belong there, and would break the continuity of the Katunes and cycles. Moreover, I think this custom of counting from the last day of the month will explain the reason for commencing the numbering of the Katunes with 13.

I think it quite probable that, if Dr. Seler will attempt to trace out on his theory the three long series on Plates 46-50, each running through 104 years, he will find that it will fail to work. If not, then it is immaterial, except as regards the succession of the epochs, whether we count the commencing days the last or first of the month.

As this theory is wholly unnecessary to explain the peculiarities of this Codex, and as Plates 25-28 appear to be based on the method of counting from the last day of the month, I see no good reason for adopting it.

Dr. Seler thinks my statement that day-numbers were not attached to month-symbols on Plates 48 and 50 of the Dresden Codex when the number was 20, is erroneous, and calls attention to certain characters which he believes are symbols for this number. The little characters he alludes to are certainly present, and, as they are not parts of the month characters, may be intended to denote the fact that the month is completed. But it is difficult to explain on his supposition the fact that the symbol on Plate 48 to which this sign is attached is that of the month *Yax*, when the date is 11 *Eb*, the twentieth day of *Chen;* and one of those on Plate 50 is the symbol for the month *Pop*, when the date is 11 *Ik*, the twentieth day of *Cumhu*. In other words, the symbol in each case is of the month following and not that to which the twenty days apply. His explanation therefore fails to solve the difficulty, and cannot as yet be accepted as fully satisfactory; nevertheless, it must be admitted that these added characters have some reference to the completion of the month.

His interpretation of the open-hand symbol by *pax*, "to beat," appears to be erroneous, as there is nothing connected with it representing the phonetic element *p*. CYRUS THOMAS.

Smithsonian Institution, Washington, D.C.

BOOK-REVIEWS.

On the Modification of Organisms. By DAVID SYME. Melbourne, George Robertson & Co. 8°.

ON account of the many questions dealt with in this book, it is difficult to do justice to its contents within our limits. The prime object of Mr. Syme's clearly-written and forcible work is to show the falsity of the theory of natural selection, and to present another hypothesis to explain the cause of the modification of organisms. The greater part of the volume is taken up with criticisms of Darwin's statements and method of exposition, and the author's ideas as to the true cause of modifications are not brought forward till near the close of the work.

They are embodied in what may be styled the doctrine of "cellular intelligence." "The cell is the biological unit," Mr. Syme asserts. "It is the irreducible vital entity; it is the seat of life and energy; it is the key that unlocks the mystery of organic modifications" (p. 142). But it is more than this. It is the element which "feels, thinks, and wills" (p. 144). In other words, it is intelligent.

Startling as this doctrine is, the author does not hesitate to claim for it a wide application. In the movements of the stamens and pistils of flowers, the selection of grains of sand by rhizopods, and the healing of wounds, he sees the operation of this "cellular intelligence."

Modifications of organisms are brought about by the stimulating influence of external conditions. "These conditions, if uniform, pronounced, and prolonged, will, according to their nature, invariably incite the organism to change in a definite direction." Mr. Syme holds that modifications result from the action of the organism itself and not from any direct influence of environment. Hence he rejects the terms "use" and "disuse," which mean only "function and its absence," and prefers to say that modifica-

tions occur in accordance with the law of "effort and abstinence."

As to whether acquired characters are inherited, Mr. Syme offers no definite opinion; and hence the most important question in this connection remains unanswered. For, if modifications resulting from the response of an organism to new influences affect only the passing generation, it is difficult to understand how they can become fixed, as they certainly do.

It should be stated further that Mr. Syme avows a belief in the existence of "vital force," which is the cause of the phenomena of life and is inherent in the living cell. He asserts that Lewes's ridicule of this idea was due to his misunderstanding the questions involved.

Our space does not admit of more than a brief mention of Mr. Syme's objections to the theory of natural selection, but many of them deserve serious attention. The case of the relation of humble-bees to clover may be cited as an example. Darwin states that "humble-bees alone visit red clover, . . . hence we may infer as highly probable that if the whole genus of humble-bees became extinct or very rare in England, . . . the red clover would become very rare, or wholly disappear" (Origin of Species, Ed. 1880, p. 57). On this point Mr. Syme remarks: "Darwin says that *T. pratense* will not produce seed unless it has been visited by humble-bees. . . . But this is quite a mistake. Red clover seed had been grown and exported from New Zealand long before the humble-bee was introduced there; and I am informed by one of the leading Melbourne seedsmen that he has been supplied with this seed, grown in the western district of Victoria, for the last 17 years; although no humble-bees have ever been introduced into that colony" (p. 112). It does not seem possible that both these statements can be true.

Many similar facts regarding the relation of insects to the color and form of flowers, the results of cross-fertilization, and the significance of secondary sexual characters, are cited by Mr. Syme in his endeavor to prove the falsity and insufficiency of the theory of natural selection. F. W. T.

The Apodidæ. A morphological study. By H. M. BERNARD. *Nature Series.* London and New York, Macmillan & Co. 8°. $2.

THIS is an extremely interesting study of the Phyllopod crustaceans, *Apus, Lepidurus*, etc., with the view of using them as a key to solve the problem as to the origin of the crustacea and the true affinities between the different groups. His study has led the author to the conclusion that *Apus* is derived from a carnivorous annelid, whose five anterior segments have become ventrally bent over. He believes he has shown the trunk of *Apus* to be a true link between the many segmented annelids and the crustacean fewer-segmented body, that it exhibits a gradual transformation of the annelidan cuticle into the crustacean exo-skeleton, while the annelidan parapodia are shown to be capable of developing every form of crustacean limb, *Apus* supplying the clue. In short, he regards *Apus* as affording an almost ideal transition form between the annelids and crustacea. Further, he shows that if this is true for *Apus*, the long-contested *Limulus* or horse-shoe crab and the Trilobites must have had a similar origin. He concludes that while only one group of modern crustacea admits of derivation from the Trilobites, all the rest except *Limulus* can be deduced from the *Apodidæ*.

Whether this hypothesis be finally accepted or not, the author's discussion throws light on many contested points, and cannot fail to have a beneficial influence on future discussions and theories of classification of the animals to which it relates.

Lessons in Elementary Biology. By T. JEFFREY PARKER. London, Macmillan & Co. 8°. $2.25.

PROFESSOR PARKER, a well known pupil of Huxley and professor of zoology in the University of Otago, New Zealand, has endeavored in this work to give an account of the structure, physiology and life history of a series of typical organisms in the order of their increasing complexity. He begins with the unicellular organisms *Amœba, Hæmatococcus, Heteromita, Euglœna, Protomyxa, Mycetozoa, Saccharomyces*, and *Bacteria*. He then takes up those unicellular forms in which there is an increasing complexity, such as *Paramoccium, Foraminifera, Diatorus*, and *Mucor*.

Next come organisms, in which complexity is attained by cell multiplication, though with little differentiation, fungi, and algæ; then solid aggregates in which differentiation is a marked factor, such as *Hydra* and *Porpita*. From these he proceeds to polygordius, mosses, and ferns. About fifteen pages are given to the higher types, starfish, crayfish, mussel, and dogfish, and to the higher plants, and special discussions on cells and nuclei. Biogenesis, homogenesis, origin of species, etc., are discussed in special chapters. In general, little criticism is suggested by the facts stated. For the teacher it may be said to be wholly unfit for elementary work, properly so-called. The author revels in a truly Lankesterian pollysyllabic vocabulary, which the 18-page double-column index by no means fully explains. A very disproportionate amount of space is given to a few low types, and the pupil cannot obtain any general idea of the animal kingdom from the book without an amount of knowledge, insight, and study not to be expected of beginners. We should think the book well adapted to deter any student who was obliged to use it from taking any further interest in the study of biology, though an accomplished teacher might find it suggestive of what to avoid in his work.

AMONG THE PUBLISHERS.

THE Duke of Argyll will publish in the fall a book called "The Unseen Foundations of Society," which is described as an examination of the fallacies and failures of economic science due to neglected elements.

— The New York History Co., 132 Nassau St., N. Y., have just ready the second volume of the "Memorial History of the City of New York."

— Harry de Windt has written a book entitled "Siberia as It Is," which appears to be a defence of the Russian system of prison management, and is intended to be a reply to Mr. George Kennan and other travellers and writers who have attacked that administration as a system of "cruelties and atrocities which is a disgrace to a civilized country and to the nineteenth century."

— It is thought that it may be possible to bring out additional volumes of Freeman's "History of Sicily," so large is the mass of MSS. left by the historian. The MS. referring to the Norman conquest is practically complete, and would form a volume by itself. Besides all this, Freeman left more or less complete materials for a history of Rome down to the time of Mithridates; considerable fragments of a history of Greece; a work on King Pippin; a fragment of Henry I.; and some other manuscripts.

— W. B. Saunders, 913 Walnut Street, Philadelphia, have just ready "A New Pronouncing Dictionary of Medicine," by Dr. John M. Keating and Henry Hamilton. The work is a voluminous handbook of medical, surgical, and scientific terminology, containing concise explanations of the various terms used in medicine and the allied sciences, with phonetic pronunciation, etymology, etc.

— The F. A. Davis Company, Philadelphia, have just ready a new edition (the tenth) of the "Book on the Physician Himself, and things that concern his reputation and success," by Dr. D. W. Cathell, of Baltimore. The Davis Company will publish early in September "The New Pocket Medical Dictionary," compiled by Dr. David Braden Kyle from the latest authorities, and containing words recently introduced into medicine; also, addenda of abbreviations, affixes, list of diseases known by proper names, list of poisons and their antidotes, etc.

— The Clarenden Press has just issued a collection of the principal speeches delivered during the French Revolution, edited by Mr. H. Morse Stephens, the English historian of that period. The orators chosen are eleven in number, including Mirabeau, Barère, Danton, Robespierre, and St. Just. Prefixed to each is a life and explanatory comment; while a general introduction deals with

French oratory in general and the oratory of the Revolution. Many of the speeches have not before been reprinted, even in France; and special attention has been paid to securing an accurate text, and to the spelling of the proper names.

— W. H. Allen & Co , London, are going to bring out with all speed Dr. Steingass's "Persian-English Dictionary," which has been six years in preparation, and which has been subsidized by the secretary of state for India. Another book is to appear in October, viz., two volumes on the history of the land revenue of Bombay, by Mr. A. Rogers, a retired civilian, who has searched the records at the India Office and traced the various changes introduced since the days when the Marathas handed over the task of gathering the revenue to the highest bidder. The work will be illustrated by a map of each collectorate, reduced from maps supplied by the Government of Bombay. Mr. Demetrius Boulger is going to write for Messrs. Allen a popular history of China.

— The August number of *The Mother's Nursery Guide* contains a number of articles that will be valuable to mothers of young children during the present season. Dr. H. D. Chapin, in an article on "Catarrh of the Stomach," gives explicit directions as to the diet necessary in this common ailment; the medical editor describes "Some Improvements in the Preparation of Infants' Foods," and Dr. S. M. Ward has a paper on "Intestinal Worms," which in some respects runs counter to the prevailing medical opinion on that subject. He says: "I am constrained to believe that young physicians pooh-pooh the suggestions of mother and grandmother too often, when asked if worms may not be the cause of certain symptoms which the child presents." The article will be found very suggestive and practical. The "Mothers' Parliament" contains letters on "Summer Recreation with Baby," "Study of Child Nature," "Choosing a Cow," etc.

— Archibald Constable & Co. have in the press and will publish shortly an authorized translation of "Antagonismus der englischen und russischen Interessen in Asien," with a map embodying the latest information.

— In the *Overland Monthly* for August, in an interesting article, entitled "The Economic Introduction of the Kangaroo in America," Robert C. Auld suggests, to take the place of the defunct buffalo, the introduction of the kangaroo from Australia, it being valuable as providing "flesh, fur, and footwear." He finds that the kangaroo "(1) Is easily domesticated; (2) breeds readily in captivity; (3) is easily maintained; (4) has excellent and abundant flesh of a very edible kind; (5) is valuable as a fur-producer; (6) makes excellent sport when at large; (7) can be bred and reared on an extensive, inexpensive scale, by simply fencing in a tract of country not suitable for other stock; (8) becomes easily and thoroughly acclimated, and is quite hardy; (9) and can be procured very easily and cheaply.'

Publications Received at Editor's Office.

BEAL, W. J., AND WHEELER, C. F. Michigan Flora. Agricultural College, Mich. 8°. Paper. 180 p.

CONNECTICUT. Fourteenth Annual Report of the State Board of Health. New Haven The State. 8°. 240 p.

FOWLER, N. C., JR., AND OTHERS. Home Warming and Ventilation. Geneva, N. Y., Herendeen Mfg. Co. 12°. Paper. 64 p.

GANTMEDE. Problems in Physics and their Application to Dynamic Meteorology. Published by the Author. 8°. Paper. 48 p.

MACOUN, JOHN. Catalogue of Canadian Plants. Part VI. Musci, Montreal, Government. 8°. Paper. 295 p.

WILLISTON, S. W., AND OTHERS. Report on the Examination of Certain Connecticut Water Supplies. 8°. Paper. 459 p.

Exchanges.

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Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

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WANTED.—The services of a wide-awake young man, as correspondent, in a large manufacturing optical business; one preferred who has a thorough knowledge of microscopy and some knowledge of photography. Address by letter, stating age and references. Optical, care of Science, 874 Broadway, New York.

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TRANSLATOR wanted to read German architectural works at sight (no writing). One familiar with technical terms desired. Address "A.," Box 149, New York Post Office.

— D. Van Nostrand Company will publish in the fall in their Science Series "A French Method of Obtaining Slide-Valve Diagrams," by Lloyd Banston, Ass't Naval Constructor, U. S. Navy, and "A Graphical Method for Swing Bridges," by B. F. La Rue.

— Professors W. J. Beal and C. F. Wheeler have prepared for the thirteenth annual report of the State Board of Agriculture of Michigan a catalogue of plants of the State. It contains 180 pages, and is much more than a mere list. In the 114 orders represented, these including the phanerogams and vascular cryptogams, there are 554 genera and 1746 species and varieties. A map showing the provisional districts into which the State is divided is prefixed to the catalogue. The distribution of each plant is mentioned, and remarks are made upon many species. It is only possible to refer to some of the numerous topics touched upon in the introductory remarks. Among them we find a general description of the topography of the State, with lists of the plants characteristic of the ten districts, lists of the plants occurring in the "Jack-pine plains," the prairies, and in the eastern and western sides of the State in the latitude of 44° 40′. There are also valuable hints in regard to the trees best adapted for planting about the home and along the roadside; planting a wild garden; trees and shrubs noted for the color of their foliage in autumn; native climbing plants; plants indicating a fertile soil; trees valuable for timber; native and introduced weeds; rare or local plants; medicinal plants, etc. Not the least interesting topic is that relating to wild fruits and nuts, the remarks of Dr. Asa Gray made in 1873 being quoted. He speculated upon what the results would have been if our civilization had had its origin in North America instead of the Old World. Apples would have developed from the wild crab; plums from several wild species; the persimmon, the paw paw, the ground nut, hickory nut, and walnut would hold the places now filled by others; and perhaps 2,000 or 3,000 years hence some of these will have taken a front rank among the edible fruits of the then existing races of men.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Botanical Laboratory, A.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School of Applied Science.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diphtheria, Tox-Albumin.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
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Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, The New Method of Protecting Buildings from.
Lissajou's Curves, Simple Apparatus for the Production of.
Maize Plant, Observations on the Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Some Recent, in the State of Washington.
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Palenque Tablet, a Brief Study of.
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Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
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Psychological Training, The Need of.
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Star Photography, Notes on.
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Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

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SCIENCE

NEW YORK, AUGUST 12, 1892.

THE CHIEF MOUNTAIN LAKES.

BY GEORGE BIRD GRINNELL.

IN Volume I., Pacific Railroad Reports, pp. 548–549, Mr. James Doty speaks of visiting the Chief Mountain Lake, and describes it and its companion sheet of water. The maps of that survey and other more recent ones show lakes to which this name is given, and references in some recent literature apply to the lakes shown on those maps.

The lakes so named are, however, not the ones mentioned by Mr. Doty, but lie about 25 or 30 miles to the north and west of those which he visited, and it would appear that since Mr. Doty's time no geographer has recognized the lakes which he saw and which he speaks of as "the well-known Chief Mountain Lake." Those called by this name on government maps and referred to in reports of the international boundary survey, published in 1876, are locally known as Kutenai Lakes, but, of course, are not to be confounded with the true Kutenai lakes lying on the Pacific slope and in the bend of the Columbia River. The so-called Kutenai, or Little Kutenai, lakes are crossed by the international boundary line and form the sources of the Little Kutenai or Waterton River, and it is probable should be known as the Waterton Lakes. Chief Mountain is a well-known landmark of north-western Montana, but the Chief Mountain Lakes are unknown in that country, and the lakes mentioned by Mr. Doty are locally known as the St. Mary's Lakes, while the large river flowing from them is called St. Mary's River. It is the most important stream meeting Belly River from the south. The town of Lethbridge, in Alberta, N. W. T., stands at the junction of these two rivers.

Mr. Doty's description of his route, of the country, and of Chief Mountain Lake is very clear, and anyone who is familiar with the region traversed will at once recognize that the lakes on St. Mary's River are Chief Mountain Lakes.

For a number of years I have been in the habit of visiting the region in question, which has been practically unknown even to hunters and trappers, and have explored a section embracing perhaps 900 square miles.

I quote from Mr. Doty's narrative of his journey from Two Medicine Lodge Creek to the Chief Mountain Lakes. Under date of May 27 he says: "The country is considerably broken by high hills and narrow valleys of spring brooks, filled with thickets of poplar and willow and flooded by beaver dams. In twelve miles came to a fine stream [now known as Willow Creek] which is a branch of Cut Bank River; and in sixteen miles reached the Cut Bank itself, the most northerly fork of Marias River. It is a rapid stream, fifty feet wide, and flows through a rich valley. . . . A broad lodge-trail leads up the valley indicating that the pass is considerably used — probably by the Pend d' Oreilles and Kootenaies who come through to hunt buffalo. Crossed at a good ford; pushed on over a range of high hills and encamped on a small stream eight miles from Cut Bank River, which is no doubt one of the sources of Milk River. . . .

"May 28. Morning cold, and the hills are white with snow. The country is quite flat and full of springs and spring brooks, which are the sources of Milk River. On our left is a heavy forest of pine timber fifteen miles in length and extending into the plain eight miles from the base of the mountains. Immediately after passing the point we obtained a view of the chief (*sic*) of King Mountain, which is a bare rocky peak of a square form, standing at a distance of five or six miles from the main chain, and connected with it by a high ridge wooded with pine. In seventeen miles came to a broad valley, the sides of which are wooded with pine and poplar; and in the bottom, five hundred feet below us, we saw the blue water of a mountain lake. This is the well-known Chief Mountain Lake. It takes its name from Chief Mountain. . . . Descending into the valley, in four miles, we reached the lake and encamped in a beautiful prairie bordering it.

"May 29. Moved up the lake three miles to its inlet and encamped. In this camp we remained until June 5th. . . .

"Chief Mountain Lake is seven miles long by one broad. Its banks are low and shore gravelly; the water clear and very deep. The valley of the lake is six miles in breadth, and is rolling prairie interspersed with groves of cottonwood and poplar, and in the low places the birch and willow. The soil is a reddish loam and is fertile, as is indicated by the luxurious vegetation. Pine of a fair size and thrifty growth is abundant and can easily be obtained, and there are inexhaustible quarries of good limestone.

"Connected with Chief Mountain Lake is another three-fourths of a mile wide and extending some nine miles into the mountains in the form of a bow, and I therefore called it 'Bow Lake.' It is shut in by mountains coming close down to the water, and has no valley susceptible of cultivation.

"The mean of observations for latitude gives as the latitude of this, the south end, of Chief Mountain Lake 48° 43′ 09″, or 17 miles south of the boundary line. . . .

Numerous little streams emptying into these lakes are filled with beaver dams and beaver, this industrious animal having been left in quiet possession of this country since the low price of its fur has rendered it unprofitable to trap them. Elk, moose, and deer are abundant, and salmon trout of large size are taken in the lakes.

"June 5. Started due north along the lake-shore, and in seven miles came to the outlet at the extreme northern end. The outlet is called in the Blackfoot language *Mo-ko un* or Belly River. It is a swift, deep stream where it comes from the lake and about 80 feet wide, and its course for some miles is due north. This is the most southerly of the head-waters of the Saskatchewan River."

This excellent description of the country makes it clear to my mind that the name Chief Mountain Lakes belongs to those lakes, in north-western Montana, which are locally known as the St. Mary's Lakes. This name was given them nearly fifty years ago by Hugh Munroe, an old Hudson's Bay man, and Mr. Doty's companion on the occasion of his visit to the lakes.

It would seem from Mr. Doty's description that the stream

which we know as St. Mary's River is the true Belly River. This seems natural and proper, for at the point where they meet, the St. Mary's is a larger stream than Belly River.

As stated by Mr. Doty these lakes are two in number, the lower about seven miles long by a mile wide, the upper perhaps eleven miles long and nowhere more than a mile in width. The lower lake lies north and south, and the upper, Mr. Doty's Bow Lake, is bent about half-way up its length, its upper or south-western half lying nearly east and west, and its lower or northern half nearly north and south. Beyond the head of this upper lake is the narrow river-valley running back in two principal branches for a dozen miles and heading on the Continental Divide. The southernmost of the two branches is much the larger of the two, and is fed by extensive glaciers, which I have visited.

The lower end of the lower lake is not more than seven or eight miles from the Chief Mountain, the most striking landmark in this region. The waters flowing into the St. Mary's River are divided from those which flow into Cut Bank and Milk Rivers, tributaries of the Missouri, by a high ridge running out from the Rocky Mountains, and known as Milk River Ridge.

BIRDS BREEDING AT HANOVER, NEW HAMPSHIRE.

BY CLARENCE M. WEED.

THE village of Hanover, N.H., is in the region dividing the Canadian and Alleghanian faunas, and possesses many animal forms from both. To assist in determining more definitely the precise limits of these faunas, the Ornithological Club of the New Hampshire College undertook last spring to record the birds breeding within five miles of Hanover. The following list includes the species observed this season by the members of the club. Especial mention should be made of the assistance rendered by Messrs. P. L. Barker, R. A. Campbell, and C. E. Hewitt.

Green Heron, *Ardea virescens*. One nest observed.

American Woodcock, *Philohela minor*. Three nests observed.

Ruffled Grouse, *Bonasa umbellus*. Three nests observed.

Cooper's Hawk, *Accipiter cooperi* One nest observed.

Acadian Owl, *Nyctala acadica*. One nest observed.

Black-billed Cuckoo, *Coccyzus erythrophalmus*. One nest observed.

Belted Kingfisher, *Ceryle alcyon*. Two nests observed.

Downy Woodpecker, *Picus pubescens*. One nest observed.

Golden-winged Woodpecker, *Colaptes auratus*. Two nests observed.

Night Hawk, *Chordeiles virginianus*. One nest found fifteen miles south-east of Hanover; and others reported by outsiders within three miles of the village.

Chimney Swallow, *Chætura pelagica*. Many nests.

Ruby-throated Humming-Bird, *Trochilus colubris*. One nest.

Kingbird, *Tyrannus tyrannus*. One nest.

Pewee, *Sayornis phœbe*. Many nests.

Traills' Flycatcher, *Empidonax pusillus*, var. *traillii*. One nest.

Least Flycatcher, *Empidonax minimus*. One nest seen at Grafton Centre, N.H., fifteen miles south-east.

Blue Jay, *Cyanocitta cristata*. One nest at Fairlee, Vt., eighteen miles north.

Crow, *Corvus americanus*. Two nests.

Bobolink, *Dolichonyx oryzivorus*. One nest.

Cowbird, *Molothrus ater*. Three eggs found in a bobolink's nest.

Red-winged Blackbird, *Agelaius phœniceus*. Two nests.

Baltimore Oriole, *Icterus galbula*. Several nests.

Red Crossbill, *Laxia curvirostra*. In 1891 a very young specimen was brought me that apparently must have been raised in this vicinity.

Yellowbird, *Spinus tristis*. Two nests.

Purple Finch, *Carpodacus purpureus*. One nest.

Bay-winged Bunting, *Poocœtes gramineus*. Several nests.

English Sparrow, *Passer domesticus*. Several nests.

Savanna Sparrow, *Ammodramus sandwichensis*, var. *savanna*. One nest.

Chipping Sparrow, *Spizella socialis*. Several nests.

Song Sparrow, *Melospiza fasciata*. Several nests.

Swamp Sparrow, *M. georgiana*. One nest.

Snow Bird, *Junco hyemalis*. One nest observed at Grafton Centre, N.H., fifteen miles south-east.

Indigo Bird. *Passerina cyanea*. Two nests seen in 1891.

Barn Swallow, *Chelidon erythrozaster*. One nest observed.

Purple Martin, *Progne subis*. One nest.

Bank Swallow, *Clivicola riparia*. Two nests.

Cedar Bird, *Ampelis cedrorum*. Two nests.

Great Northern Shrike, *Lanius borealis*. Two nests.

Red-eyed Vireo, *Vireo olivaceus*. One nest.

Yellow Warbler, *Dendroica æstiva*. One nest.

Chestnut-sided Warbler, *Dendroica Pennsylvanica*. One nest.

American Redstart, *Setophaga ruticilla*. One nest.

Oven-bird, *Seiurus aurocapillus*. One nest.

Catbird. *Galeoscoptes carolinensis*. Two nests.

Brown Thrush, *Harporhynchus rufus* One nest.

House Wren, *Troglodytes œdor*. One nest.

Short-billed Marsh Wren, *Cistothorus stellaris*. A nest supposed to be of this species is reported.

Chickadee, *Parus atricapillus*. Two nests.

Tawny Thrush, *Turdus fuscescens*. Three nests.

Hermit Thrush, *T. pallasi*. Two nests.

Robin, *Merula migratoria*. Several nests.

Blue Bird, *Sialia sialis*. Several nests.

Of course this list includes only a portion of the birds breeding here, but it may serve as a basis for future observations.

New Hampshire College.

HOT WEATHER IN MARS.

BY PROFESSOR EDWIN J. HOUSTON.

THE recent severe, protracted, hot weather, that existed in the central and eastern portions of the United States during the latter part of July, formed, in all probability, but part of various general phenomena produced by profound solar disturbances.

So many of the earth's natural phenomena find their origin in the solar radiation, that it is impossible to vary either the amount or the distribution of the solar energy without markedly modifying terrestrial phenomena. Such influences, however, are not limited to terrestrial phenomena; they must extend beyond the earth and be shared by all the members of the solar system.

Natural phenomena form but links in endless chains of cause and effect. An evolution or expenditure of energy, such, for example, as that following a sun spot, produces a number of allied phenomena which are themselves the causes of subsequent phenomena, and these in turn the causes of still other phenomena, the chain extending in most instances far beyond our ken.

There has been unusual solar activity during 1892, as has been evidenced by an unusual number of sun spots. The great spot observed in Philadelphia and elsewhere in the early part of the year was one of the largest ever studied, and since that time numerous other abnormally large spots have appeared.

It would seem that these rather unusual outbursts of solar energy have produced the following terrestrial phenomena, viz.:—

(1.) The recent brilliant auroral displays.

(2.) Magnetic storms, or marked disturbances in the values of the magnetic intensity, in inclination and declination.

(3.) Unusually severe electric storms, as evidenced by the existence of abnormal earth currents. These electric storms are in reality connected with the magnetic storms.

(4.) Marked disturbances in the earth's meteorological phenomena. These have been evidenced by the long spells of unseasonable weather that have occurred so frequently in the United States during 1892, one of which was the recent unusally hot weather before alluded to, the unusual severity of which accords well with the unusual solar activity.

So, too, does the severity of the allied phenomena. Take, for example, the auroral displays, which have seldom been equalled in these latitudes for brilliancy. So also the electric-storms and magnetic-storms, which have been unusually severe during 1892. According to the observations of Mr. Finn and others, as many as eleven such storms were recorded during this time. Their dates were as follows: February 13, March 6, March 12, April 24, April 25, April 26, May 16, May 17, May 18, July 12, and July 16.

The storm of July 16 was unusually severe, and caused great disturbances on the various telegraph lines. The earth-currents were so strong that the lines could be operated entirely by means of earth-currents. This was done, for example, in the case of one of the lines between New York and Boston. On the same day, July 16, an enormous spot appeared on the sun.

And now for possible extra-terrestrial influences and phenomena. The recent opposition of Mars has brought that planet nearer the earth than she has been at any time since 1877, and nearer than she will ever be again until 1909. The opportunity has therefore been particularly good for studying those peculiarities of the surface that have always been of such interest to astronomers.

Some observations recently made on Mount Hamilton appear to show a marked decrease in the mass of snow within the polar caps, as is inferred from certain characteristic markings at these points of the planet. This disappearance is unusual, and would seem to indicate unusually hot weather in our sister planet. The Martian thermometer has probably been way up, and the weather has, to form a phrase from the fiery color of the planet, been at a red-heat.

We may add, therefore, another effect produced by the unusual sun-spot, viz., 5. The extra-terrestrial effects.

Of course the influence may be mutual. It may be that the unusual proximity of Mars may be the cause of the great number of spots, in which case we may thank Mars for the recent terrific heat.

"FLATHEAD" DEER.

IN the *American Naturalist* for August, 1887, were given some instances of the occurrence among deer of hornless specimens. Here we shall summarize these, preparatory to giving in full some original particulars furnished us by a German correspondent.

Lord Lovat is quoted as having seen *humle* (hornless) stags. They are able to thrash stags of their own or greater than their own weight. Several of them were undisputed masters of large herds.

Mr. Horatio Ross has also shot them. They are more frequent than generally supposed. They are no whit inferior to their horned brethren. A full-grown *humle* is very formidable in fight. During the rutting season Mr. Ross has seen one in possession of a large herd of hinds, who drove off all rivals.

Both these gentlemen's experience refers to Scotland. The following mentioned special cases refer to Germany. H. von Nathusius of Altaldensleben, Saxony, and Ludwig Beckman have supplied very interesting information which is well worth reading to those interested in venery.

These hornless deer occur wild, they write, and are very fertile and impressive. In the *Illustrirte Zeitung*, published in Leipzig (Oct. 2, 1886), there is a picture of a fight between a horned and a hornless stag, in which the hornless stag displays the mastery. Hornless stags have been mentioned in German sporting literature since the seventeenth century.

These are cases of what is regarded as variation, but which really appear to be referable to atavism, as will be immediately seen.

There are two species of deer that are normally destitute of horns as a characteristic. The first of these is the musk-deer; these have peculiarly long canine teeth. These (*Moschus moschiferous*) are natives of Thibet and Nepaul. The second is the water-deer, *Hydropetes inermis*. It is found in the marshes of the Yangtze, above Chin-kiang, China. The Chinese are strongly averse to the flesh, which Europeans, for want of better, pronounce tolerable.

Passing from living to extinct forms of deer, we find that, tracing them backwards, they become more and more simple as to horns, till reaching the lower miocene no member of the family is possessed of antlers. It will thus be admitted that the claim that instances of hornless deer of the present time are only cases of atavism, or reversion to the early condition of the head of the species, is simply the truth. Further, the above facts prove that horns are of the nature of acquired characters — a rather interesting fact just now to bring out in connection with the Wiesmannia that is raging.

The following is a translation of the communication we received from our German correspondent:—

"The hunter of the deer species has for long designated the deer which are destitute of antlers by the name of 'flat-heads,' or *mœnche*. On the skull of such deer appears a so-called *hornbase*, usually the real bearers of the antlers, remarkably stunted and entirely overgrown with the elongated hair of the forehead. The cause of such striking appearance is often held to be the long-continued inbreeding occurring in certain districts, or the lack of new blood obtained by bringing in deer not related.

"If we notice how the deer and roebucks which have been confined for domestication and freely fed with oats, rye, peas, corn, acorns, chestnuts, and beechnuts, often develop uncommonly large and branching antlers, it seems just to conclude that a lack of these and other means of nourishment hinders the growing of horns. In fact the so-called

'flatheads' are more particularly found in the pine-wood regions, where game is obliged to subsist solely upon heather forage (sweet broom), and where food is to be found only in occasional places.

"As transitory forms, there are also in such districts, in addition to the few flatheads found at all times, deer having one 'scurr' or stunted horn, while the other horn is well developed, bearing perhaps ten to twelve branches, and the majority of the rest of the deer have only small, smooth antlers of light color, some curiously bent or spirally twisted. Deer which instead of antlers bear a long, straight, spear-like horn on one side were formerly called 'provincial murderers,' as they were considered a very dangerous enemy of other deer during the rutting season, and on which account their destruction was sought.

"In the main, these so-called deformities, and even the total absence of antlers on the flatheads, can in no way be considered an indication of the lack of procreative power, nor can they be classed with the abnormal forms or the total loss of antlers, which results from injuries, and which reappear in their young. The flathead deer are seldom unequal in strength or weight to the others of the same age and the same district, but occasionally excel the latter in these respects. They also early enter the rutting season, and show themselves equally ready for the conflict. Their art and manner of fighting are singular enough; like the female, they rise up high on their hind feet, and with their fore-feet they, from above, mercilessly strike their antagonist. It is remarkable how the antler-bearing antagonist intuitively enters such conflict by rising on his hind feet, making no use of his terrible weapons. On such occasions the flathead, having developed superior skill in his movements, almost always puts to flight in a few rounds much larger deer with immense forked horns. Also at other seasons the contests may be observed in regions where the flatheads are found, and where at times a troop of such game is run together into a narrow space, as is the case occasionally during the preparations of a suspended hunt; yet those encounters are less fierce and soon ended, as they are brought on by the momentary invitations and accidental meeting of the deer in the press."

Have there been any cases of deer, bisons, etc., with 'flat' or hornless heads noticed in America? A.

SOME ANALOGIES BETWEEN MOLECULES AND CRYSTALS.

BY JOHN W. CALDWELL.

Chemistry and crystallography are closely related branches; they are, indeed, but parts of one great whole. The special design of chemical laws is to present the methods and conditions of the re-arrangement of atoms, which re-arrangements we generally denominate chemical reactions. The laws of crystallography, on the other hand, primarily relate to the element of form. While the first series of laws concerns the arrangements of atoms, the second takes cognizance of the arrangements of molecules: while the one considers the influence of the chemical force of affinity, the other is concerned with the physical force of crystallization.

A consideration and comparison of the most important laws of the two series will develop, I think, a most interesting parallelism and correspondence. Thus, the first great law of chemistry is that of definite proportions, in which is stated the principle of the fixed and unchanging composition of every compound. It finds its satisfactory analogue in the crystallographic law of the constancy of the interfacial angles, first propounded by Steno in 1669, and re-enunciated by Romé de l'Isle in 1783. It affirms that for a certain crystal species, under conditions of absolute identity of chemical constitution and equality of temperature, the corresponding interfacial angles in different individuals will be found always to be equal and constant; and this holds in imperfect as well as perfect crystals. It is evident then, that what the law of definite proportions is, in regard to chemical constitution, the law of constancy of the interfacial angles is, in respect to crystalline form.

Another equally perfect and beautiful correspondency obtains between the law of multiple proportions and that of the rationality of the indices. The former emphasizes the simple multiple ratio of one element as it unites with some other element to form two or more compounds; whereas the latter, an important crystallographic law, attributed to Haüy, articulates the remarkable fact that the modifications of specific crystalline form always take place by a multiplication of one or more of the index values (or the reciprocals of these, the parameter values), by small and simple numbers or fractions, by rational and not by irrational quantities. The analogy here existing is easily appreciated: in the one case we have presented the method (namely, by simple multiple ratio) of the formation by weight of chemical compounds containing the same elements; in the other, the method, also by simple multiple ratio, by which is determined the modification of fundamental form of a crystalline species.

A third analogy is found in the comparison of the law of valency or equivalence in the chemical domain, and the law of replacement or substitution in the crystallographic. The first of these, of course, refers to the relation by weight in which the various elements react; potassium being exchanged for sodium in the proportion of 39 of the former to 23 of the latter; and, in like manner, chlorine (35.5) for bromine (80). The chemical type or idea is continued in such reactions, although one of the original constituents may have been substituted by another element. Correspondingly, the law of replacement allows the crystallographic type or idea to be continued, though by altered agents. Thus, the recognized substitution-power of magnesium and calcium allows, in compounds of the latter, a greater or less substitution of the former, without change of crystalline form; calcite and dolomite are both rhombohedral in crystallization, the angles of the two differing slightly.

A fourth analogy is expressed in the allotropisms and isomerisms of chemistry, and the dimorphisms and polymorphisms of crystallography. The allotropism of elements is probably to be explained upon the basis of different atomicities of the elemental molecule; but, however explained, like atoms are able in many cases to build up structures sometimes as variant in physical characters as are the diamond and ordinary charcoal, having chemical dispositions as different as common phosphorus and red phosphorus. Similar suggestions apply to the subject of isomerism. Now, to this, crystallography presents an analogue in the dimorphism so often to be seen in minerals; one and the same substance showing itself in nature in two (sometimes more) crystalline forms, i.e., belonging to distinct crystalline systems; take, as illustration, calcite (rhombohedral) and arragonite (orthorhombic). Here again diversity of form is set over against diversity of physical and chemical characters.

A fifth analogy (the last that I shall venture) bases upon

the hypothecation of actual molecular structural form — configuration, according to Wunderlich's proposed term to express stereo-chemical relations. The subject of molecular configuration is comparatively new; still we are becoming familiarized with diagrams and models intended to represent such relations. Many of us may have been at first indisposed to accept these views as anything more than visionary and fantastic; but the more we have pondered them, the more have we been impressed with their significance and beauty. Shape, form, and volume must be attributed to molecule as well as to mass; the only trouble has been in regard to the former, the apparent audacity and hopelessness of any attempt to penetrate matter to such depths. The new and most refined sense furnished to us by the use of polarized light, makes us aware of isomers identical in every respect, save their response to this delicate physical agent. Optical isomers have given rise, under the crucial investigations of such men as van t'Hoff, LeBel, Wunderlich, and V. Meyer, to the hypotheses of the asymmetric carbon atom, and the tetrahedral arrangement of the valence-bond, and the saturating atoms or radicals. The simple and symmetrical tetrahedron of methane must be accepted as the perfect analogue of a crystal of the same geometric form; and the optical isomers resulting from the different arrangements of the same atoms or residues around an asymmetric carbon atom, may, in like manner, be taken as the analogues of enantiomorphous crystals, as of quartz, right-handed and left-handed; the pairs in each case being perfectly equivalent, but not superposable.

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NOTES AND NEWS.

THE cause of the terrible disaster at St. Gervais is now being investigated by several men of science. There can be no doubt that it originated in the small glacier called the Tête Rousse, which is nearly 10,000 feet above sea-level. According to a correspondent of the London *Times*, who writes from Lucerne, Professor Duparc is of opinion that the habitual drainage of this glacier had for some reason or other became either totally blocked or obstructed; the water gradually accumulated in its natural concavity or bed; and the ever-increasing volume had exercised such an enormous pressure as to force a passage and carry away a portion of the face of the glacier with it. The mass of ice and water rushed down the rocks which dominate the glacier of Bionnassay, not in a single stream but in several, and then reunited into one enormous torrent at the foot of the Bionnassay glacier. A different theory is held by Professor Forel, of which the correspondent of the *Times* gives the following account: Professor Forel does not see how a quantity of water sufficient to force away so large a portion of the glacier could possibly accumulate in so small a body as the Tête Rousse, which has a total superficies of less than one hundred acres. It slopes freely on three sides; it is, in fact, one of the most abrupt of the whole chain of Mont Blanc; and, in a glacier of this description, with an altitude of nearly 10,000 feet, there are none of the conditions of a great accumulation of water. In his opinion, therefore, we must look for the main cause of the disaster in the natural movement and breaking up of the glacier. He estimates the volume of ice which fell at between one and two million cubic metres. The mass, first in falling and then rushing down the rapid slope, became transformed, for the most part, into what he calls a lava of ice and water. The ravine, he says, through which this avalanche rushed shows no traces of any great evacuation of water; in the upper portions of its transit there is no mud and no accumulation of sand, but, on the other hand, there are great blocks of glacier ice strewn everywhere, and at several points he found portions of powdered ice mixed with earth. Then, again, if this had been simply a torrent of water falling, it would have found its way down the more violent inclines, instead of, as in this case, passing straight over the frontal moraine at the foot of the glacier. In this higher region, therefore, all the evidence points to an avalanche of ice, which, starting at an altitude of nearly 10,000 feet, and descending at an incline of 70 per cent for 5,000 feet, was pulverized by its fall, a large portion of it being melted by the heat generated in its rapid passage and contact with matters relatively warm. It rushed into the ravine by the side of the glacier of Bionnassy and joined the waters of the torrent which issues therefrom, and, further aided by the stream of Bon Nant, it became sufficiently liquid to travel down the lower portions of the valley at the slighter incline of 10 per cent, and yet retained sufficient consistency to destroy everything in its passage. That this torrent was not composed merely of mud and water is proved, he says, by the fact that it did not always maintain the same height when confined to the narrower ravine, and that the remains on the sides of the rock show it to have been a viscous substance rather than fluid.

— At a meeting of the London Chamber of Commerce on July 25, as we learn from *Nature*, Mr. J. Ferguson read a paper on "The Production and Consumption of Tea, Coffee, Cacao (Cocoa), Cinchona, Cocoa-Nuts and Oil, and Cinnamon, with reference to Tropical Agriculture in Ceylon." He referred to the position of Ceylon, its forcing climate, its command of free cheap labor, and its immunity from the hurricanes which periodically devastated Mauritius, from the cyclones of the Bay of Bengal, and from the volcanic disturbances affecting Java and the Eastern Archipelago. The plantations of Ceylon afforded, he said, the best training in the world for young men in the cultivation and preparation of tropical products, and in the management of free colored labor. The cultivation of cane-sugar, although tried at considerable outlay on several plantations forty and fifty years ago, proved a failure. More recently experiments by European planters with tobacco had not been a success, notwithstanding that the natives grew a good deal of a coarse quality for their own use. Although cotton growing had not been successful, the island had proved a most congenial home for many useful palms, more particularly the coconut (spelt without the *a* to distinguish it and its products from cocoa — the beans of the shrub Theobroma cacao) and palmyra, as also the areca and kitul or jaggery palms. Within the past few years Ceylon had come to the front as one of the great tea-producing countries in the world, India and China being the other two, with Java at a respectable distance. Mr. Ferguson said one of the chief objects of his paper was to demonstrate which of the products of the island it was safe to recommend for extended cultivation in new lands, and which were already in danger of being over-produced, and he had arrived at the conclusion that coffee, cacao, and rubber-yielding trees were the products to plant, while tea, cinnamon, cardamoms, cinchona bark, pepper, and even palms (for their oil) did not offer encouragement to extended cultivation. Statistics relating to the total production and consumption were given in an appendix.

— A third edition, largely rewritten, of "The Microscope and Histology," by Simon Henry Gage, associate professor of physiology in Cornell University, has been issued by Andrews & Church, Ithaca, N. Y. This volume contains much useful information, systematically arranged, and will, no doubt, be appreciated by those who are learning to use the microscope and desire to familiarize themselves with the most approved microscopical methods. Chapter I. relates to "The Microscope and its Parts;" Chapter II. to "The Interpretation of Appearances," which will be of special value to beginners; Chapter III. gives detailed information with reference to "Magnification, Micrometry, and Drawing;" Chapter IV. treats of "The Micro-Spectroscope and Micro-Polariscope;" Chapter V. of "Slides, Cover-glasses, Mounting, Labelling," etc.

— B. Westermann & Co. will publish in September the third volume of Conway and Crouse's translation of Karl Brugmann's "Comparative Grammar of the Indo-Germanic Languages." The fourth and concluding volume, with a full index, will be issued next year.

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CURRENT NOTES ON ANTHROPOLOGY. — XII.

[*Edited by D. G. Brinton, M.D., LL.D.*]

Ligurians, Iberians, and Siculi.

PROFESSOR G. SERGI occupies the chair of anthropology in the University at Rome, and Professor G. Niccolucci that in the University of Naples; but these two scientists of eminence are far from agreeing as to the ethnic position of the Ligurians, or as to the shape of their skulls. Professor Niccolucci described some alleged Ligurian crania, which seemed to show them to have been a round-headed people, and hence, the Professor inferred, of "Turanian" origin. But Professor Sergi insists that the said skulls were only those of modern Modenese, and neither ancient nor Ligurian. His own authentic series of Ligurian skulls proves them, on the contrary, to have been long-headed, with narrow noses, orthognathic, and with no similarity to Turanians; but with a very close likeness to the ancient Iberian type, such as the brothers Siret exhumed from the neolithic deposits of southern Spain. What is more, in two series of neolithic skulls from southern Sicily he proves that identically the same peculiarities recur; so that the ancient Siculi and Secani who held that region before the Greeks came, he believes to be branches of one stock, and both of them out-posts of that same Ligurian people who in proto-historic times occupied most of the coast of the Mediterranean Sea, from the Straits of Gibraltar to the tip-end of the Italian peninsula. For him, Siculi, Sicani, Ligures, Iberi, as ancient ethnic names, all refer to branches of the same stock; and the cave men of Mentone and the Arene Candide in Italy, and of Cro Magnon in France, alike furnish us with specimens of the Ligurian cranial form. His interesting essay is in the Bulletino di Paletnologia Italiana, December, 1891.

The Meaning of Ethnography.

In the first number of a new journal, *Bibliothèque de l'Alliance Scientifique*, Tome I., Fasc. I., appears what we should call a "symposium" on the meaning and the objects of Ethnography. The writers are Jules Oppert, Claude Bernard, Jomard, A. Castaing, Leon de Rosny, Jules Simon, D. Marceron, and other well-known names.

One perceives in most of their contributions that confusion of terms which is so prevalent in France, and which is so severely and justly criticised by Topinard in his last work, "L,Homme dans la Nature," pp. 7, 8, 23, 24, etc. By its derivation and according to its early and correct usage, ethnography means a description of the actual condition of a people or peoples. So it was employed by Niebuhr and Campe early in the century, and so it is used to-day by Gerland, Ratzel, and the other leading ethnographers outside of France; and so it should be in France. A word common to science should connote the same ideas everywhere.

Jomard defines it as "the science whose final purpose is to explain the progress of humanity." C. A. Pret gives us the terse sentence, "Ethnography is the social history of humanity." Another contributor puts it, "Ethnography seeks to define the laws of the moral and intellectual evolution of man." Carnot studies it, "to discover a solid foundation for my political faith;" de Rosny, "for the new lights it casts on the grand and enigmatical problem of destiny."

These are brave words, and they tell us a great deal about the meaning and purpose of ethnology, but are wholly misapplied with regard to the term ethnography in its correct sense, either in French or English. They illustrate the need of a correct nomenclature in this science.

The Primitive History of Mankind.

A volume on this subject which is at once scientific and popular is a decided benefit to the study of anthropology; and such a one we have in Dr. Moritz Hoernes's "Die Urgeschichte des Menschen nach dem heutigen Stande der Wissenschaft" (Vienna, H. Hartleben, 1892). It is clearly printed and abundantly illustrated, and its scope may be guessed from its size — 672 large octavo pages. It takes in the whole of what is now called the "pre-history" of Europe, beginning with the alleged remains of tertiary man and extending down to the time when history proper takes up the thread of the development of the human race in that continent. Several chapters of an introductory character explain the nature and objects of pre-history, and examine into what we may understand by the earliest conditions of culture in the human race.

Dr. Hoernes is not a mere book-maker, as is so often the case with authors of popular scientific works, but is a prominent member of the Anthropological Society of Vienna, and a practical laborer in the vineyard of archæology. He has a right, therefore, to press some of its wine wherewith to treat the general public. May they quaff deeply and become intoxicated with the attractions of this new science, full of promises and full of mysteries!

Early Development of the Art-Faculty.

The development of the art-faculty is as much an ethnic as it is a personal trait. As we find among our own acquaintances some singularly gifted in this respect, and others, of equal or greater general ability, quite devoid of it, so it has been with nations and tribes in all periods of culture. In lower stages of development it is more ethnic than personal, the individual then being less free.

For these reasons the scepticism which has met the discovery of free-hand drawings on horns and bones dating from palæolithic times is not well founded. Those from the caves of La Madeleine in France representing the mammoth

and reindeer are well known; still more remarkable are those from the Kessler hole, near Schaffhausen, in Switzerland. A sketch of a reindeer feeding, now in the Rosgarten Museum, Constance, and one of a horse, in the Schaffhausen Museum, both from this locality, are so true to nature that one is surprised that they could have been drawn by a person not regularly instructed. Yet the draughtsman lived at a time when the Linth glacier covered the site of the present city of Zurich, and the musk-ox and reindeer pastured where now grow the vineyards of the Rhine.

Several curiously inscribed stones and shells have within the last few years been found in the eastern United States, regarded by their owners as the work of aboriginal artists. Two of them represent the mammoth: others, scenes from life, as battles. While not to be rejected at once, grave suspicion attaches to all such for obvious reasons, the first of which is the constant recurrence of frauds in American antiques. There is now no doubt that Professor Wright was deceived in the small terra-cotta image from a great depth in Montana which he described; and it is very easy for an enthusiast to fall into such snares.

An Aboriginal Pile-Structure.

A late issue of the Peabody Museum of Archæology is a report upon pile-structures in Naaman's Creek, near Claymont, Delaware, by Dr. Hilborne T. Cresson. It will be remembered that in *Science*, Vol. XV., p. 116, etc., there was a correspondence on the character of the structure which these pile-remains indicated. The facts as set forth in the pamphlet now published show that at the mouth of Naaman's Creek three groups of pile-buts were discovered, in a line running from north to south across the creek. In the immediate vicinity, at various depths in the mud and gravel, about 700 stone implements were found, some quite rude, of argillite, others highly finished, of jasper, slate, quartz, etc.

As the mouth of the creek where it falls into the river was evidently a favorable camping and fishing ground for the natives, these implements might reasonably have been expected in such a locality. Was their presence in any way related to that of the piles? Dr. Cresson conjectures that the piles originally formed native fish-weirs. It may be so, but a careful study of the plans which he furnishes, and an inspection of the piles themselves at Cambridge, lead me to think they were intended as supports for some structure which rested upon them. Were they the rude piers of some early Swedish bridge across the creek? Were they the abutments of an ancient wharf? Were they the foundations of dwellings? The average size of the groups, about 12 by 6 feet, would answer the requirements of the latter theory; and palefittes were by no means unknown among the American aborigines.

MEDICAL BOTANY.

BY CHARLES FREDERICK MILLSPAUGH, M.D.

In looking over the prospectuses of the various medical colleges of the United States, one fails to find in a great majority of them anything to indicate that the important subject of medical botany is taught One wonders at the apathy of medical institutions in this respect when pausing to consider the fact that seven-tenths of the drugs in general use have a vegetable origin, and an action upon the animal economy analogous to their botanical relationship.

I fully agree with Professor Barnes[1] in his statement that, to the general public (and I am sorry to add, to the average Board of Instruction as well), the first thought arising to the mind when botany or botanist is mentioned, is a vague picture of "a sort of harmless crank," wandering about fields, woods, and bogs, picking insignificant weeds and carrying them home. principally to tear them in pieces when he gets there. I urge, with the professor, the necessity of modernizing botanical instruction in colleges and normals, and would add to the list pharmaceutical and medical institutions. Examine the text-books on materia medica used in these latter institutions, and what do you find? Simply an alphabetical arrangement of drugs. This does not meet the needs of the subject treated, for a student should be trained to study drugs in accordance with their analogy to other drugs, and not according to their indexial position in a language. In order to do this he must have, not a rudimentary knowledge of botany and vegetable chemistry, but a thorough and systematic attainment of the subject, not only as represented by the flora of the campus and surrounding woods and fields, but of the world at large. Upon opening these actual text-books we shall find atropine, an inflamatory poison, preceded by aspidium, an anthelmintic, and followed by aurantia, a simple carminative, none of these bearing the least rational relation to the others. An index would have found these drugs readily, while their disposal in this manner will teach the student nothing, nor will it in the least assist his memory to retain the uses of them.

Drugs of botanical origin are as closely allied to each other medically as the plants from which they are derived are botanically; therefore in the above illustration atropine should have been preceded by stramonium and followed by hyoscyamus. Again genera and families of plants have true and constant familial and generic drug action, and the individual species of these have idiosyncracies of action peculiar to themselves. To continue the same illustration, belladonna and atropa, with their *atropa atropine;* stramonium, with its *datura-atropine;* and hyoscyamus, with its *hyoscyamine;* together with other Solanaceæ — to which botanical family they belong — all cause delirium, but its character differs in each drug; they all dilate the pupil, but the expression of the face under the dilation is dissimilar; they all cause spasmodic action, but the spasms are varied; and among other symptoms they all cause an eruption of the skin, but in each case the eruptions may be readily distinguished. This study may be carried through the whole range of the drug action, not only in the family here presented, but through the whole natural plant system as well. This being true, should not the medical student's first training in materia medica be a thorough course in systematic botany?

Pure science in the collegiate study of drugs has of late been set aside for the greater study of the less useful questions of etiology and diagnosis. Of what immediate care to the patient are hours of scientific and exhaustive guesswork as to what caused him to be ill, when he knows that this is followed by but a moment's thought expended upon the more vital question of what drug should be employed to make him well again? Take up the first medical magazine at your hand; in it you will doubtless find a long dissertation upon some case in practice. Column after column will be found to be devoted to the elucidation of points of diagnosis and etiology, and suppositions, perhaps, of bacterial invasion and cell disintegration, then a line or two to therapy, then the post mortem.

Careful, comprehensive, differential, and comparative study of botany and vegetable chemistry in their relation to

[1] Science, Vol. XX., page 62.

materia medica must be followed in order to educate a good therapist, and the sooner our medical institutions make a requisite of this branch, the better it will be for patients treated by their graduates.

ON THE PRESENT TENDENCY TOWARDS HIGHER STANDARDS OF PROFESSIONAL EDUCATION.

ONE cannot but observe with pleasure, in the present general advance and spread of higher education, that this advance is affecting not only the institutions of higher learning themselves and the general population, but also the strictly professional or technical schools. And whilst I wish in this short paper to refer more especially to law and medicine, my remarks will apply also to other — perhaps to all other — professions.

The medical education of this country has, deservedly enough, for many years been looked upon with little favor, and has ill stood the test of competition with the methods of other countries; but now we are observing a great change in this respect, and there is no doubt that before many years the degree of M.D. from an American university will be as valuable a certificate on its face as can anywhere be obtained. Medical courses of four years' duration are now being adopted, or have already been adopted, by the leading medical schools in the country. The requirements in preliminary education have also greatly increased, and one may hope that before long such subjects as botany and zoology may be added to the requirements of a good English and general education from the intending student of medicine. State legislation itself has not been idle, and we find in the State of New York, for example, that no person can practise medicine without undergoing an examination conducted by the State Board of Examiners. A requirement of preliminary education has also been added, and though as yet no more than an elementary education is required, we may hope for better things in future.

As regards the profession of law, the advance is perhaps even more marked; more marked, that is, as regards legal education, for we do not find that the advance in the requirements for admission to the bar has been so considerable as might be desired, though they have been by no means neglected. Three-year law-school courses, which not so long since were unheard of, have now become the rule rather than the exception; and even in those schools which still see fit to maintain a two-years' course for the degree of bachelor of laws, a graduate course has been commonly added. Towards the general extension of the study of law so as to include the Roman or Civil Law, the tendency is by no means general, caused no doubt by the non-requirement of this branch for admission to the legal profession. Some universities, indeed, in their college courses, offer instruction in this subject; but it must be remembered that the majority of law-students are not college graduates, and so the breadth of their legal knowledge will be measured by the instruction given in the law school, however the depth and extent of what subjects they do touch upon may be increased afterwards. Yale is, I believe, alone among the universities in this country which gives extended courses in the civil law, and encourages their study by the bestowal of a degree (that of D.C.L.); but even then the course is one taken by but few students, and, as the catalogue says, is intended for those who intend to be something more than practising lawyers. This is not as it should be, and we must look to the future for more general study of this subject, for without it law can hardly be taught as a science, for law is — and should be known as — a science.

Education preliminary to the study of law has also risen greatly. Latin is now a usual requirement, and we may doubtless soon see it a universal one.

The day is not far distant then, let us hope, when the title Doctor or Lawyer will in itself mean an educated man.

N. H.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Elm-Leaf Beetle, Galeruca xanthomelæna Schr.

IN *Science*, No. 492, for July 8, 1892, Dr. C. V. Riley records the facts, that at Washington, D.C., the imagos from the first brood of larvæ of the above insect had already appeared, and that eggs from beetles of this summer brood had been obtained June 28. In a letter dated July 27, Dr. Riley informs me that from these eggs larvæ had been obtained and that these larvæ were then pupating. Dr. Riley's observations are positive, and prove

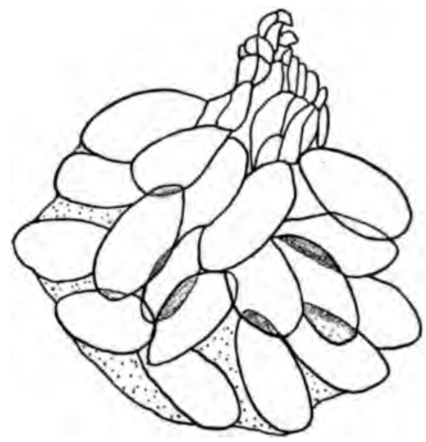

FIG. 1.

that there are two broods at least of this insect at Washington, D.C. They prove also that the beetles will mate and oviposit readily in confinement, and that there is only a brief interval between the appearance of the beetles and oviposition for the second brood of larvæ. This means that the beetles of both sexes are sexually mature when they emerge from the pupæ, or that they mature very rapidly and copulate within a very brief period after assuming the imaginal form. The accuracy of these observations I do not question; but neither do I admit that I am in error in claiming that in New Jersey, north of New Brunswick, there is only a single brood of this insect.

My acquaintance with the beetle at New Brunswick began in 1889, in which year I protected the large number of elms in and near the college campus and about the Experiment Station by spraying with a London purple mixture. In the Report of the College Experiment Station for 1888, Dr. George D. Hulst, my predecessor in office, had stated that there were two broods of the insect annually; and on the appearance of the summer brood of beetles, I made ready to spray again as soon as the second brood of larvæ should begin to appear on the protected trees. They never did make their appearance, and I was unable to find a second brood on any other trees in the city. Dr. Hulst, in response to questions, informed me that he had noticed only one brood of larvæ in 1888; but there had been a cyclonic storm about the time they became mature, which freed the trees and covered the ground beneath them with thousands of the slugs, only a few of which ever found their way back to their food.

To this destruction he attributed the absence of the second brood which published accounts led him to expect. I recorded these facts in my Report for 1889, claiming positively that there was a single brood only at New Brunswick. My observations, carefully repeated in 1890 and 1891, simply confirmed this conclusion.

These observations were presented at a meeting of the Entomological Club of the A. A. A. S., and, though he could not gainsay my facts, Dr. Riley yet doubted the correctness of my conclusion, as his paper in *Science* also shows. I therefore resolved to repeat my work yet more carefully in 1892 and to make it conclusive if

FIG. 2.

possible. The first signs of the beetles were noticed on May 17, in the form of small round holes eaten in a few leaves; on the 19th a few of the beetles were seen, and after that date they increased rapidly in numbers for some time. The weather for a few days was cold and wet, the insects were sluggish, and no eggs were observed until May 29. For special observation I selected a small tree between my home and the laboratory, which I passed several times daily, could see all parts of easily, and which was a prime favorite with the insects.

Eggs began hatching June 6, while yet oviposition continued. After the middle of the month the hibernating beetles diminished in number, and on the 30th not a beetle could be found. June 29 the first pupæ were formed and larvæ matured daily thereafter

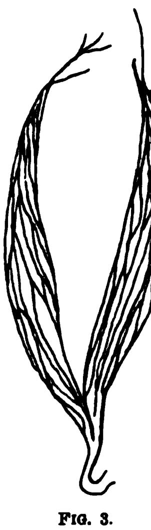

FIG. 3.

in greater abundance. At this date a very few unhatched egg-clusters were yet to be found, but of those collected, only one mass gave larvæ July 1. Since that date and up to date of writing (Aug. 1), there has not been a cluster of eggs on any tree that I have examined, and I have closely scanned many dozens, large and small. Early in July I gathered in over 200 pupæ and mature larvæ under the observed tree, and placed them in breeding-cages and jars Adults began to appear July 8, and very rapidly thereafter in the open air as well as in my cages. It is interesting to note that on June 29, when I secured the first pupa, Dr. Riley already had eggs of a second brood. The beetles bred by me fed readily and abundantly for nearly three weeks, and then more slowly, until at this time they refuse to feed entirely. During all this time there has not been a copulation nor an egg-mass in any jar, nor have I observed a copulation or an egg-mass in the open air. On July 30 I observed a disposition on the part of my insects to refuse food and to hide among the dry leaves. I therefore selected a considerable number of them of both sexes for examination. In all, the sexual structures were immature or undeveloped. In the male it was difficult to get the testes, because they were mere empty thread-like tubes. In the females the ovaries were mere bundles of tubes without even partially-developed eggs. I gathered rather more than forty specimens from the trees, and found the same state of affairs, except that in one specimen the ova had begun to develop. This morning I selected a few fresh and fat specimens — all females, as it proved — and though the abdomen was much distended, the distension was caused by the fully-dilated crop and stomach, and the ovaries were yet less developed than in any previously examined. Soon after the beetles appeared in May, I examined a number of them and found that in all the sexual structures were fully matured. In the males the testes were quite rigid coils, which were easily removed entire, while in the females the ovaries so completely filled the abdominal cavity that it was impossible to open it without detaching or crushing some of the eggs. The beetles earliest matured are now seeking winter quarters.

I consider my observations, now carried on for four years in succession, as conclusive of the fact that at New Brunswick, N.J., there is only a single brood of this species annually. I present herewith figures of part of one ovary (Fig. 1) of a beetle taken May 25, in which the oviduct and part of the developed eggs are removed; of the ovaries of a beetle taken July 30 on the trees, in which they were best developed of all those examined (Fig. 2); and of the ovaries of a specimen three weeks old (Fig. 3), with which all the others that were examined agreed in that they were at least no more developed. All the figures were made by the use of a camera with a Zentmayer binocular stand, 2-inch objective, *a* eye-piece, and drawing-board six inches from camera. The vagina is not shown in Fig. 3, but is as large as that shown at the base of Fig 2, and this is the only structure that has the full size. I have not considered it necessary to figure the male organs, though the difference between spring and summer beetles is equally striking. In none that I examined did I find anything like a developed testicle.

JOHN B. SMITH, Sc.D.

Rutgers College, Aug. 1.

Wheat Rust and Smut.

As a general rule the Bulletins issued from the various State Agricultural Experiment Stations, while not notable for the amount of original matter they contain, are fairly accurate in their statements, and their recommendations are to be relied upon. Occasionally errors creep in, some of them the result of haste in compilation, others the result of not being conversant with the latest information on the subjects discussed. In the former category must be placed the statement made in Bulletin No. 88 of the Michigan Agricultural Experiment Station that wheat rust can be successfully treated by what is known as the Jensen hot-water method; that is, immersing the seed in water having a temperature between 132° and 135° F. Wheat rust has been long under investigation. It has caused a loss of about £2,000,000 sterling annually in Australia, and it is safe to say that there is not a country or a State where wheat is grown that has not suffered from its ravages. The fact is that while wheat *rust* is described and illustrated in the Bulletin in question, the treatment for prevention of wheat *smut* is given. It is needless to say that what is applicable to one is not to the other. Farmers who expect to prevent wheat rust by the hot-water treatment will be sorely disappointed. Perhaps their disappointment will result in making them question, without cause, however, the benefits to be derived from treating for smut. Between the two diseases there is a vast difference; one (rust) attacks the leaves, the other (smut) attacks the grain. In the latter case treatment of seed will be

beneficial. In the former it will do no good whatever. This is mainly because in the former infection takes place probably by means of spores disseminated by the wind, so that whole fields soon become infected. It cannot be denied that an effectual remedy for wheat rust is still a great desideratum.

Joseph F. James.

Washington, D. C., Aug. 5.

The Ancient Libyan Alphabet.

In *Science*, July 15, Dr. Brinton has some remarks on this subject, which I have read with surprise. The old Libyan alphabet, he says, "appears to have been in common use among the Berber tribes of north Africa long before the foundation of Carthage (1), . . . and in its forms is almost entirely independent of the Phoenician letters (2). It is composed of consonants called *tifinar* (3), and vowel-points, known as *tiddebakin*. The latter are simple dots (4), the former are the lines of a rectangle, more or less complete (5). Several of them are found in the oldest Etruscan inscriptions (6). . . . The writers who have given especial attention to this little-known subject are Faidherbe, Duveyrier, Halévy, Bissuel, and, recently, Dr. Collignon (7)."

To avoid repetition, and facilitate reference, I have numbered the points in this passage on which I should like to offer a few observations.

1 and 2. What authority has Dr. Brinton for referring this alphabet to pre-Carthagenian times, and for stating that its forms are almost entirely non-Phoenician? I have hitherto regarded the Punic origin of the Libyan letters as an established fact accepted by all epigraphists of weight, and notably by Mommsen, who unhesitatingly recognizes their Semitic descent: "The Libyan or Numidian alphabet now as formerly in use amongst the Berbers in writing their non-Semitic language is one of the innumerable offshoots of the primitive Aramæan type. In some of its details it seems even to approach that type more closely than does the Phoenician itself. We are not, however, therefore to conclude that the Libyans received it from immigrants older than the Phoenicians. It is here as in Italy, where certain obviously more archaic forms do not prevent the local alphabet from being referred to Greek types. All that can be inferred is that the Libyan alphabet belongs to the Phoenician writing older than the epoch when were composed the Phoenician inscriptions that have survived to our time" (History of Rome, iii., 1).

It follows that the Numidian ancestors of the Berbers received their writing system from the Carthaginians, earliest Phoenician settlers on the north African sea-board, and, consequently, that the Libyan alphabet had no currency "long before the foundation of Carthage." The archaic forms referred to by Mommsen were the forms in use in Tyre and Sidon in pre-historic times, whereas the extant Phoenician inscriptions date from historic times; hence the discrepancies between the latter and those preserved by the Berbers, most conservative of all peoples.

3. Not the consonants alone, but the whole system (mainly, of course, consonantal as being Semitic) is called "tifinar," or rather "tifinagh." The sounds *gh* and *rh* interchange in the Libyan dialects (*Ghet* and *Rhet; Melghigh* and *Melrhirh*, etc.), so that it is not always easy to decide which is the original sound. But here there is no doubt that *gh* is organic; and Barth, for instance, always writes *Tefinagh*, plural *Tefinaghen:* "There was in particular a man of the name of Sáma, who was very friendly with me. On reading with him some writing in *Tefinaghen*, or the native Berber character, I became aware that this word signifies nothing more than tokens or alphabet. For as soon as the people beheld my books, and observed that they all consisted of letters, they exclaimed repeatedly, 'Tefinaghen — ay — Tefinaghen!'" (Travels, V., p. 116). There is, however, more in this word than Barth was aware of. When stripped of the common Berber prefix *te*, it reveals the "Finagh," i.e., "Phoenician," or "Punic" origin of the letters in their very name. Note the stress still falling on the root *fin*, as in *Poeni*.

4. F. W. Newman explains *Tidebákka* (pl. *Tidebákken*) to mean "a dot on or under the letter" (*Vocab.*), in fact any diacritical mark of the kind, and not merely vowel signs. Some, however, are doubtless used to voice the consonants, as in Hebrew. Like other Semitic alphabets, Tefinagh had originally no vowels, but only three breathings, transformed in some systems (Greek, Italic) to pure vowels, in others (Cufic, Arabic) to semi-vowels and vocalic bases. But all this merely tends to strengthen the view that the Libyan is a Semitic alphabet.

5. This statement is to me unintelligible. In the published Libyan alphabets (Fr. Ballhorn, "Alphabete orientalischer und occidentalischer Sprachen," p. 8; Hanoteau, "Essai de grammaire de la langue tamachek," and others) curves occur quite as frequently as straight lines, while acute decidedly prevail over right-angles. Of the eight letters copied by Barth (I., p. 274) two only can be described as "more or less complete rectangles," forms which are certainly less common than, for instance, in Hebrew and Estranghelo.

6. It would be strange if resemblances did not occur between the Libyan and the characters of "the oldest Etruscan inscriptions," seeing that both have a common Semitic origin, the former directly through the Phoenician, the latter indirectly through the archaic Greek. But such resemblances obviously lend no color to Dr. Brinton's peculiar views regarding Libyco-Etruscan linguistic affinities.

7. Of the writers here referred to, Faidherbe and Halévy alone can be regarded as specialists. On the other hand, there are serious omissions, such as Dr. Oudney, who in 1822 first discovered the existence of the Berber alphabet; F. W. Newman, "Patriarch of Berber philology;" Mommsen and Hanoteau, as above; lastly, A. Judas, who was the first to clearly establish the Phoenician origin of these characters in a paper entitled "De l'Ecriture libyco-berber," contributed to the *Revue Archéologique* for September 1862.

A. H. Keane.

Broadhurst Gardens, London, N.W.

BOOK-REVIEWS.

Handbook for the Department of Geology in the U. S. National Museum. Part I. Geognosy.— The Materials of the Earth's Crust. By George P. Merrill. Washington, Government Printing Office, 1892. 89 p. 12 pl.

The U. S. National Museum is probably the greatest institution of its kind in this country. The museums located in New York, Cambridge, Boston, Philadelphia, and other large cities present to the residents of those places and to students many facilities for study. This is particularly the case with the American Museum of Natural History in New York and the Museum of Comparative Zoology in Cambridge. But neither one of these has been planned upon so extensive a scale, or is destined to attain such mammoth proportions, as the National Museum at Washington. The country at large is familiar with some things to be found at the museum from the numerous expositions at which displays of its treasures have been made; but no one who has not visited and lingered long in its great but crowded quarters at the National Capital can adequately realize the broad foundation upon which it is based, or the immense variety and scope of its collections. There are gathered together here materials which cover all human arts and all the natural sciences — anthropology in its widest sense, from the rude, chipped-flint implement of palæolithic man to the delicate *Sevres* china of civilized man; rocks and fossils from the most ancient formations to the most recent; animal forms from the minutest insect that flies to the hugest creature of land or sea. Scarcely an object, indeed, in which man has had aught to do, or to find interest in, but is to be found here.

The collections are not, either, lying idle. A large corps of curators is constantly at work, either arranging the old collections or studying and comparing the new. The results of these studies appear from time to time in the Proceedings of the Museum — a publication scarcely known to the public at large even by title, on account of its limited circulation — or else in the Annual Reports of the Museum, which are more widely known from being distributed as congressional documents. Unfortunately, these last usually appear from two to three years after the date they are stated to be reports for.

In the early days, when the Smithsonian Institution was the

repository for the national collections, these reports touched but lightly upon the vast amount of material stored away. Within the past five years, however, and since the National Museum has become recognized as the place where all government expeditions shall deposit the material collected by them, a large volume has been annually devoted to this branch alone. Those which have been issued are filled with information upon a great variety of subjects, although special attention seems to have been devoted to ethnology. Naturally, other matters are treated of, and it is likely that, in the future, place will be given to all departments as fast as the several curators find time or see fit to devote their attention to making the collections under their charge known to the outside world.

The article under review, for it is merely an excerpt issued under a separate cover from the Report of the Museum for 1890, and covering pages 503–591 of that report, is one which, while designed to be a handbook for the collections, is in reality a condensed account of the rocks forming the earth's crust. In it one will find concise descriptions of the sixteen principal elements that go to make up rock masses; a list of the original and secondary minerals of these rocks; an account of the macroscopic and microscopic structure of rocks; the chemical composition (in brief) and the color. The most extensive portion of the handbook, however, is that which deals with the kinds of rocks. Under this head we have described the four varieties of (1) *aqueous*, those formed through the agency of water either as chemical precipitates or as sediments; (2) *æolian*, those formed from wind-drifted meterials; (3) *metamorphic*, those changed by dynamical or chemical agents from an original aqueous or igneous origin; and (4) *igneous* (eruptive), those brought up from beneath the surface in a molten condition. It is not necessary to go into details as to all these classes, or to mention the various divisions made of them; an extract or two will serve to show the character of the remarks. For example, under Chlorides we read: —

"Sodium chloride, or common salt, is one of the most common constituents of the earth's crust. From an economic standpoint it is also a most important constituent. It occurs in greater or less abundance in all natural waters, and, as a product of evaporation of ancient seas and lakes, it occurs in beds of varying extent and thickness among rocks of all ages wherever suitable circumstances have existed for their formation and preservation. Salt-beds from upwards of a few inches to thirty feet in thickness occur in New York State and Canada, while others abound in Pennsylvania, Virginia, Ohio, Michigan, and Louisiana. There are also numerous surface deposits, of great extent, in the arid regions of the West" (p. 533).

Under the head of *Siliceous group*, infusorial or diatomaceous earth, we find the following: —

"This is a fine white or pulverulent rock composed mainly of the minute shells, or tests, of diatoms, and often so soft and friable as to crumble readily between the thumb and finger. It occurs in beds which, when compared with other rocks of the earth's crust, are of comparatively insignificant proportions, but which are nevertheless of considerable geological importance. Though deposits of this material are still forming, e.g., in the marshes of Yellowstone Park, and have been formed in times past at various periods of the earth's history, they appear most abundantly associated with rocks belonging to the Tertiary formations.

"The celebrated Bohemian deposit is some fourteen feet in thickness, and is estimated by Ehrenberg to contain 40,000,000 shells to every cubic inch. The Australian specimen exhibited is from a deposit four feet in thickness. In the United States, beds are known at Lake Umbagog, New Hampshire; Morris County, New Jersey; near Richmond, Virginia; Calvert and Charles Counties, Maryland; in New Mexico; Graham County, Arizona; Nevada; California; and Oregon. The New Jersey deposit covers about three acres, and varies from one to three feet in thickness; the Richmond bed extends from Herring Bay, on the Chesapeake, to Petersburg, Virginia, and is in some places 30 feet in thickness; the New Mexico deposit is some six feet in thickness and has been traced some 1,500 feet; Professor LeConte states that near Monterey, in California, is a bed some 50 feet in thickness; while the geologists of the fortieth-parallel survey report beds not less than 800 feet in thickness of a pure white, palebuff, or canary-yellow color as occurring near Hunter's Station, west of Reno, Nevada.

"The earth is used mainly as a polishing powder, and is sometimes designated as *tripolite*. It has also been used to some extent to mix with nitro-glycerine in the manufacture of dynamite. Chemically the rock is impure opal" (p. 540).

It is in such books as these that the young student finds his best helps. The information given is accurate; the paths are made pleasant; the rough places are smoothed. It is greatly to be desired that the other departments of the Museum may have as useful descriptions of their contents. JOSEPH F. JAMES.

Washington, D.C., Aug. 8.

Phases of Animal Life, Past and Present. By R. LYDEKKER. London. Longmans, Green & Co. 8°. $1.50.

THIS admirable series of essays, which was originally published in *Knowledge*, has been reprinted in an attractive form both as regards typography and illustrations. The essays are concisely written, and reveal a wealth of knowledge on the part of the author. The explanations of scientific discoveries and conclusions are neither too elementary nor too technical, and the essays will be read with pleasure as well as profit by anyone interested in zoological lore.

The earlier and the closing chapters of the book are devoted to the consideration of various morphological adaptations, such as protective armor, the modifications of limbs for flying and swimming, and the forms of teeth and horns. The author then takes up the fossil reptiles, describing the characteristics of the ichthyosaurs, plesiosaurs, and dinosaurs, and explaining the differences between them. Other chapters relate to the tortoises, the extinct gigantic birds, the egg-laying and marsupial mammals, and other animals whose structure and history are of special interest. There is for the most part no close connection between the various topics, but they are all important and worthy of attention.

In the treatment of morphological subjects Mr. Lydekker makes use of certain metaphorical expressions which may possibly mislead the unwary reader. Various modifications are spoken of as if they resulted from the conscious, intelligent action of the animals concerned. It is stated, for example, that the ancient mail-clad fishes "appear to have come to the same conclusion as the more advanced divisions of the human race, that a massive armor for the protection of the body is an encumbrance" (p. 7). Again, the reptiles "held divided opinions as to whether a bony coat of mail was or was not a thing to be retained as a permanency." Such expressions are calculated to induce a wrong way of looking at things unless, indeed, the Lamarckian idea that modifications result directly from the efforts of organisms is to be accepted.

One is surprised to find in the writings of so good a naturalist as Mr. Lydekker the statement, or insinuation, that the separation of the amphibians from the reptiles is due to "that tendency to multiply terms for which they (the naturalists) are so celebrated" (p. 8). Mr. Lydekker, of course, well knows and, indeed, takes pains to explain, that the separation was made on account of the fact that the typical representatives, at least, of these two groups are very different both in structure and mode of development. There have undoubtedly been many instances in which naturalists have coined new names unnecessarily, but this is certainly not a case in point.

These are small defects, however, and are entirely overbalanced by the excellencies of the book. It deserves and will repay perusal.

AMONG THE PUBLISHERS.

"THE Delaware Indian as an Artist" is the subject of a fully illustrated paper by Dr. Charles C. Abbott, to appear in *The Popular Science Monthly* for September. The objects of art which are represented include carved-stone gorgets, a wooden spoon-handle, wooden masks, and other carvings, many of them showing much skill. Professor J. S. Kingsley will describe "The Marine Biological Laboratory at Wood's Holl," giving pictures of its building and interior arrangements. Something is told also of its neighbor, the laboratory of the United States Fish Commission. Surgeon George M. Sternberg, U.S.A., will have a paper on "In-

fectious Diseases: Causation and Immunity," giving the facts that have been established in this field up to date; and 'A Further Study of Involuntary Movements," by Professor Joseph Jastrow, supplementing a previous paper on this subject, will appear.

— Charles Scribner's Sons issued on Aug. 8 Stevenson's long-expected book on Samoa, entitled "A Footnote to History," being a narrative of the varied history of that island for the past eight years.

— J. B. Lippincott Company's August Bulletin of New Publications contains, among other announcements, the following: "Photography: Its History, Processes, Apparatus, and Materials. Comprising Working Details of all the more Important Methods," by A. Brothers. In the preparation of this work, the author's aim has been to produce a Handbook for the Use of Students of Photography, which should give the results of practical experience, and include — as far as possible within a moderate compass — information gathered from many sources, and not readily accessible. The newer methods have been dealt with in sufficient detail, and special attention given to the processes in use prior to the introduction of the gelatino-bromide method. Some of these processes are in danger of being neglected through the facilities which the newer methods have introduced. But, as Professor Brothers demonstrates, the new processes do not give results equal to the old, and are totally unsuitable for some purposes — such as making negatives for photo-lithography, and in various other ways. Where practicable, the plates illustrate the processes described, thus making the work distinctly more serviceable to students. "In Starry Realms: a New Work on Astronomy," by Robert S. Ball; "Regional Anatomy in its Relation to Medicine and Surgery," by George McClellan, M.D.; "Steam Boilers: their Defects, Management, and Construction," by R. D. Monro. Of books in press, "A Short Course on Zoology Designed for High Schools and Academies," by C. De Montmahon and H. Beauregard; translated and adapted for American schools by Wm. H. Greene, M.D. "Recent Rambles, or in Touch with Nature," by Charles C. Abbott, M.D.

— Ginn & Co. have nearly ready "German Orthography and Phonology," by George Hempl, Assistant Professor of English in Michigan University. They will publish in the fall "Fourier's Series, and Spherical, Cylindrical, and Ellipsoidal Harmonics," with applications to problems in mathematical physics, by W. E. Byerly.

— *Outing* for August opens with the first instalment of Wheelman Frank G. Lenz's description of a cycling tour around the world. The rider is at present somewhere on the broad western plains, en route for the Pacific coast, and during his two-year jaunt he will traverse Japan, China, India, Persia, Turkey, Austria, Germany, Holland, France, England, Scotland, and Ireland. Mr. Lenz will communicate his experiences to *Outing* from convenient points of his journey, illustrating his articles by photographs taken by himself. The opening chapter describes the trip

Publications Received at Editor's Office.

APGAR, AUSTIN C. Trees of the Northern United States. New York, American Book Co. 12°. 224 p. $1.

ARKANSAS GEOL. SURVEY. Annual Report for 1890. Little Rock, Press Print. 8°. 474 p.

BEAN, TARLETON H. Notes on Fishes Collected in Mexico. Washington, Government. 8°. Paper. Ill.

BENEDICT, JAMES E. Corystoid Crabs of the Genera Telmessus and Erimacrus. Washington, Government. 8°. Paper. Ill.

BOLLES, T. DIX. Chinese Relics in Alaska. Washington, Government. 8°. Paper. Ill.

EIGENMANN, CARL H. The Fishes of San Diego. Washington, Government. 8°. Paper.

HOFFMAN, B. B. The Sloyd System of Wood Working. New York, American Book Co. 12°. 242 p. $1.

JEFFERSON, SAMUEL. Columbus, An Epic Poem. Chicago, S. C. Griggs & Co. 12°. 239 p.

LINTON, EDWIN. Notes on Avian Entozoa. Washington, Government. 8°. Paper. Ill.

MASON, OTIS T. The Ulu, or Woman's Knife of the Eskimo. Washington, Government. 8°. Paper. Ill.

RATHBURN, MARY J. Catalogue of Crabs of the Family Periceridæ Washington, Government. 8°. Paper.

RICKOFF, REBECCA D. A Supplementary First Reader. New York, American Book Co. 12°. 122 p. 25 cts.

SHUFELDT, R. W. The Evolution of House Building among the Navajo Indians. Washington, Government. 8°. Paper. Ill.

SHUFELDT, R. W. A Maid of Wolpai. Washington, Government. 8°. Paper.

SMITH, JOHN B. Revision of the Genus Cucullia, etc. Washington, Government. 8°. Paper. 86 p.

STYNEGER, LEONHARD. Preliminary Description of a new Genus and Species of Blind Cave Salamander. Washington, Government. 8°. Paper. Ill.

STYNEGER, LEONHARD. Notes on a Collection of Birds made in Japan. Washington, Government. 8°. Paper.

WILLIAMSON, MRS. M. BURTON. An Annotated List of the Shells of San Pedro Bay. Washington, Government. 8°. Paper. Ill.

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Volumes XVII. and XVIII.

OF

SCIENCE

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across the Alleghanies from Pittsburgh via Washington to New York, and is profusely illustrated.

— The experiment station of Cornell University conducted an experiment in 1890, showing very decided beneficial results from removing the tassels from a part of the growing corn; their calculations showing about fifty per cent gain from the rows from which the tassels were removed over the alternate rows on which the tassels were allowed to remain. This remarkable showing caused a similar experiment to be undertaken at the Ohio station in 1891. Thirty-two rows of corn, running over quite uniform land, were selected upon which to make this trial. On Aug. 1, the tassels were pulled from each alternate row. At cutting-time four rows, having the tassels removed, were cut and shocked together, then four rows from which the tassels were not removed were shocked together. Continuing this throughout the thirty-two rows, they had when done four shock rows of each. When husked these shock rows were weighed separately. They also separated the merchantable from the unmerchantable corn, and calculated the yield of each separately per acre. They find that the unmerchantable corn from the four plots from which the tassels were removed averages 26 per cent, while the averages from the other four rows is 21 per cent unmerchantable. The calculations also show that the average yield per acre is about one bushel less than where the corn was left undisturbed. It is probable that the tassels were not removed in this experiment early enough. To insure or even make possible beneficial results from removing tassels, the pulling should be done as soon as they appear, and before the stalk has weakened itself in an attempt to perfect the tassel. The theory upon which this experiment is based is that the strength that would otherwise go to the maturing of the tassel and production of pollen is diverted to the use of grains, and from their more complete development more corn is produced. The fodder in this experiment was not weighed, because back-water from a high river damaged it to such an extent as to make the weight unreliable.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

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SCIENCE

NEW YORK, AUGUST 19, 1892.

THE BIRD ON ITS NEST.

BY MORRIS GIBBS.

ALTHOUGH many interesting points in relation to the nesting habits of our friends, the birds, have appeared, I have yet to see anything concerning the position which the prospective parent assumes while incubating. The subject has been of much interest to me, and in the past years many observations have been made, which plainly indicate that the proprietors of nearly all nests "have their exits and their entrances." Many there are, as the kingfishers, woodpeckers, and other species, which reach their eggs by a single opening or burrow, and these of necessity must emerge from the same source; but all seem to have a well-defined position in sitting, as we shall see.

All can remember the attitude of the domestic hen, turkey, or goose, and how rarely this position is changed; and with the wild bird the tendency to a shift is even less, for with barn-yard fowls we can alter their posture by placing a board in a variety of positions about the nest, but with the inhabitants of the wood any interference generally results in desertion. The robin when building her nest often tries how her brooding breast is to fit the growing structure, and this, too, when a bare, flat platform gives no indication of the elevated sides to follow. Later, the male sits in the forming cup, and speculates, probably, on the outcome of his efforts, and views the outlook from the crotch. During the four days of egg-laying the female is not on, or rather in, the structure to any extent, unless the weather is cold or wet, and she assumes almost any position. It is only after the duties of incubation begin, a period which lasts fourteen days to a dot, that the robins adopt a standard, shared in by each of the pair. The male, who shares in the duties of sitting, when going to take his trick, almost invariably flies towards his mate in the same path, and arriving at the back door, just as his feet are about to touch the edge, the female is seen to dart forward between the branches which comprise the front door. This front door, as I prefer to call it, is then really the exit, and toward it the incubating bird always points her bill. It never directs toward the tree-trunk, and generally points towards an open space in the foliage when in a thick-leaved tree or bush.

With all birds, so far as I am able to learn, the exit is a point of observation for the sitter, from which it can get a view of friends and foes. The owls and hawks from an elevated position can command a fine view of the surroundings. With all aquatic birds the sitter almost invariably occupies a position presenting toward the water. Shore birds, as the sandpipers, rest on their nests in a position to best view the stream or pond. Rails and gallinules face the water, the latter usually building so that they can plunge from their homes directly into their favorite channels. The loon, who builds, or rather forms, its nest away out from shore in a mass of vegetable matter, usually the foundation of an old muskrat's house, invariably faces the open, deep water. From that position it can slide into the lake at a second's notice. Anyone can prove this position of the loon by examining the premises when the owner is away. The nest proper is merely a trough-like depression, evidently formed by the bird's efforts at hollowing, rather than in building up the sides. This oblong depression is a foot and a half long and over ten inches wide, and the eggs are always placed from three-fifths to two-thirds of the distance from the front end.

In a large number of nests of the brown pelican, which I examined on an island in Indian River, Florida, all gave evidence that the old birds sat in one position, usually with the front to the water. It was interesting to note, that, although the very young birds, which occupied many of the nests, assumed no regular position, the larger young nearly all presented towards the shore.

In the case of ruffed grouse and quail, the position occupied while on the nest is invariably that which gives the best view of the surroundings from the more or less concealed retreat. Who ever heard of a grouse's nest where the old bird faced into the brush pile or toward the stump or log?

The arboreal sparrows, vireos, and many other smaller birds usually sit upon nests built on horizontal limbs, with the head from the trunk, and when the nest is much elevated the position is usually chosen so that the sitter will face the prevailing wind. Birds will nearly always, when on or off the nest, face the wind; and, if observations are taken, nearly all birds on the nest will be found in one position if a strong wind is blowing.

FOOT DEFORMITY AS THE RESULT OF UNSCIENTIFIC SHOES.

BY W. M. L. COPLIN, M.D., AND D. BEVAN, M.D.

IN approaching the subject of scientific foot-dress, one of necessity combats the traditions, experiences, and fashions of centuries. If we are to judge of the foot coverings handed down to us as relics from the courts of France, Spain, England, and Germany, we can but conclude that for an extremely long period of time, probably eight or ten centuries, the dressing of the human foot has been, even in the so-called civilized countries, but slightly different, and only in degree, from the customs of the followers of Confucius for thousands of years. Fortunately for art, unfortunately for the history of civilization, so called, the artist of olden as well as modern times has not copied, except in portraiture, the cramped foot, the narrow toe, the elevated heel, and the pinched instep, which have long accompanied the human foot. It seems reasonable to suppose, however, that the Roman artist and critic, and the Grecian as well, fully attempted to give us the perfect foot as found in the well-developed Grecian woman of the day. The sandals worn at the time when Rome was in her splendor were undoubtedly so constructed as to afford ample opportunity for the development of the foot, and exhibit the beauty of its conformation. The gladiators, if we are to judge of their physique by the rude representations which are handed down to us from their times, trained in extremely loose-fitting sandals, and

fought their battles in "shin buskins," rarely wearing any foot covering at all.

The first criminal step taken was that of lacing the entire shoe; this error led rapidly to the pinching of the foot, and in order to retain the foot well forward in the shoe the high heel became a necessity. This is not the histological reason why the high heel was first put on the shoe, but it is evident to the thinker that, with the narrow toe worn during the reign of Queen Elizabeth, it would have been practically impossible to have prevented excoriation and severe rubbing of the heel had the shoe remained flat; hence to prevent this the heel was elevated, and the foot shot forward to the toe of the shoe, and its return toward the heel prevented by the elevation of its posterior extremity.

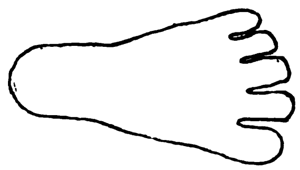


FIG. 1.—Infant's foot, never worn a shoe. Scale, three-eighths of an inch to one inch.

This can be but a brief *résumé* of the history of the improper foot-wear; it is sufficient to say, that, as fact, the wooden shoe or the cast shoe is more conducive to maintaining the normal contour of the foot than the pinchy leather shoe.

To return to the consideration of our subject proper, aside from the influence of evolution upon the human foot, we are to remember that the foot of a child as nearly represents the ideal of a perfect foot as anything of which we can conceive; so, taking that for a basis of our observation, let us glance for a moment at the essential features in maintaining the beauty of this small piece of God's handiwork.

As briefly outlining the course which the deformity of the foot pursues as the result of improper shoeing, the accompanying diagrams are presented. They are in no sense pictures, and are made by placing the foot upon paper and carefully tracing a continuous line around it; the same is true of the

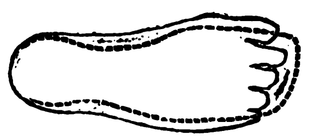


FIG. 2.—Five year-old child's foot, showing beginning deformity. Scale, two-eighths of an inch to one inch.

shoe except that it is drawn in broken lines. It will be observed that the broadest part of Fig. 1 is at the tip of the toes, that the toes are separated, that the pencil line can be readily made between the toes without displacing or pushing them aside. The foot is almost triangular in shape; from the tip of the little toe, a line projected backward will touch almost the entire length of the foot, and the inner margin of the big toe being continuous with the line at the side of the foot. The toes are straight, and when turned up, that is, fully extended, they will be separated from each other and evince perfect freedom of motion, both flexion and extention in all the phalanges. The instep is well arched, both on the plantar and dorsal surfaces; the foot is pliable; and, when extreme flexion is made, it will be manifest in the arch as well as in the toe; the heel is not found extending backward, it is round from above downward posteriorly and from side to side; there is no sharp angle, and the thickening of the plantar skin begins gradually. This foot has never worn a shoe, and therefore does not show any of the evidences of the slowly developing deformity. Next we will consider the foot of a child five years old (Fig. 2). It will be observed that the great toe is beginning to deflect towards its fellows; the little toe deflects slightly towards the inner side of the foot; the greatest width of the foot is no longer at the tip of the toes but at the metatarso-phalangeal articulation; the toes can be but slightly separated by voluntary effort on the part of the individual. The toes are beginning to show slight stumping, and the overriding of the little toe and of its neighbor is beginning to manifest itself. The foot, although fat and plump, has not the smoothness, softness, and roundness which the infantile foot possesses. A line drawn from the heel along the outer or inner margin of the foot but slightly touches the great toe or the little toe at its base, and neither of them at their first phalangeal articulation. The tracing of the shoe shows exactly how the foot must be compressed in order to adapt itself to the shoe; and it is to be remembered that these drawings were made upon the outside of the shoe, and the foot must go on the inside of the covering of which this is an outside tracing. The narrowing of the toes must inevitably follow this pinching.

Passing on to the next degree, we have that of an adult foot (Fig. 3). The deformity here is sufficiently well marked to speak for itself; a step further it becomes more marked, and reaches its climax in Figs. 4 and 5, where we have a later stage thoroughly represented. Here the great toe is overriden by

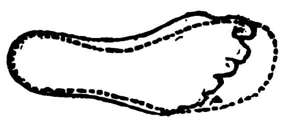
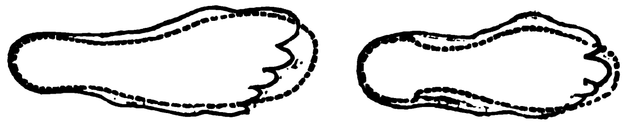


FIG. 3.—Adult's foot, showing increased deformity. Scale, one-eigth of an inch to one inch.

the second toe, which lies parallel with the third toe; they are stumped, with nails and sides flattened. The fourth toe bends under the third toe. The bend at the first and second phalangeal articulation is angular, and both angles are surmounted by corns. The little toe bends far under the fourth toe, and at the metatarso-phalangeal junctions of the small toe and of the great toe articular enlargements are well advanced. Lines drawn along the outer and inner margin of the foot no longer touch either the great or little toe. The heel now projects backward as a result of the lacing to which the ankle has been subjected. The foot is flattened in the sole, and in some cases enlargement will be observed in the tarso-metatarsal articulation of the great or, more commonly, the little toe. These changes, as represented by the above succession of figures, are but the history of one foot, if it could be followed from infancy to adult life or later. The skin of the sole of the foot will be thick, and in no small number of cases corns will be situated either upon the heel or internal or external ball of the foot. During the development of these deformities the gait of the patient — for by this time the sufferer is a patient either of the doctor or the chiropodist — will have materially changed. Instead of the free, swinging gait of childhood and youth, easily and comfortably maintained, we have now the mincing, narrow gait with evident unsteadiness in the ankles, a tendency to prevent pushing forward of the foot and a manifest effort required in ascending or descending stairs or steps. There is a poorly developed calf as a result of the heel being highly elevated. The leg is narrow and flat; the calf is deficient and the tendo-achilles prominent. Climbing stairs, or go-

ing up hills, or working bicycles or pedals, or standing on tip-toe, or dancing, tires out the calf, produces pain in the hamstring muscle and a weakness in the back. These conditions are not rarely ascribed to ingrowing toenails, corns, or a tender foot, while in fact they are the legitimate outgrowths of slowly developing anatomical deformities. Added to the improper shape of the shoe and its



FIGS. 4 and 5.—Adults' feet, showing the advanced stages of deformity. Scale, one-eigth of an inch to one inch.

poor construction, we have the element of bad leather with stiff inflexible joining, all going as important factors of the development of the deformity. The question of the arrest of these changes, the prevention of deformity, lies, of course, entirely in properly made shoes. The shoe should certainly be the same width from the metatarso-phalangeal articulation to the tip of the toe. Crowding should be prevented. The soles should be flat, no heels to jab the foot forward upon the toes. The weight should be transmitted directly to the plantar arch, and not to the ball of the foot. Stockings should be wide and not taper at the toes, having a uniform width as in the shoe from the ball to the tip of the toe; they should be seamless in the area coming in contact with the toes and soles. The texture of both the stocking and the shoe should be pliable, and neither should be worn long enough to become saturated with moisture.

PHONETIC VALUE OF THE *CH'I* GLYPH IN THE MAYA GRAPHIC SYSTEM.

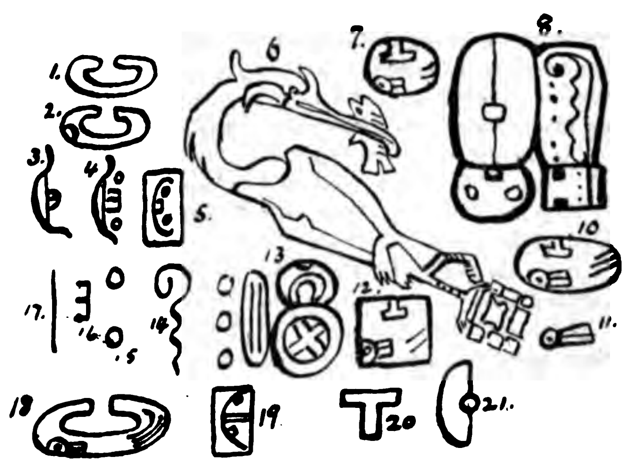
BY HILBORNE T. CRESSON, A.M., M.D.

THE *Ch'i* glyph, which figures so extensively both in the hieratic and demotic script of the Mayas, seems to have been used in the most archaic forms of their graphic system, as it appears in their altar tablets of Copan (see Fig. 3 of the illustration accompanying this article), and it is also to be remarked among the ikonomatic decorations of various ancient Maya cities.

Ch'i, in Maya, means "to seize" or "hold" with pins, thorns, or claws, or other sharp-pointed objects; this would be clearly ikonomatic for *Ch'ic* or *Ch'i*. In 1876, while in Paris, it was my good fortune to examine, at the library of the École des Beaux Arts, an excellent photograph of the tablet to the left-hand side of the doorway of Casa, No. 3, Palenque, which, in a previous article published in *Science*, I have suggested is probably a bas-relief of *Kukuitz*. The design and technique of this masterpiece of the Maya scribe-sculptor's art is especially fine, particularly the ikonomatic decorations which ornament the figure of the god. The head-dress of the figure represents feathers, maize leaves, the quetzal head, and other decorations, notably that of a heron (*Baac-há*) in the act of pinching a fish (*cay*) in its powerful bill. The suggestion of *Baac-há* in the act of pinching *cay* in its bill (Fig. 6), although it recalled by means of the various phonetic components of the crane's head, neck, and eye, that the scribe intended to suggest to one's mind *ha-ca-ba*, or *hach kabah*, or it may be *ah kaba*, also suggested that *ch'i*, "to pinch," "bite," was implied by the action of the heron's bill. It would make the sentence more complete, for the fish, *cay*, is, in fact, but a determinative, showing that *ch'á* is intended rather than *ch'i*, thus giving us "Ba-haá-chá" or "haá-chá-bá," an excellent rebus-like suggestion of *ah kaba*, which in Maya = "he who has a name." I notice that in the Casa, No. 2, tablet, Palenque, that the *main clouée* of Brasseur calls attention to "ah kaba," and a sculptured vase recently discovered in Yucatan, now in the Peabody Museum, has this same hieroglyph incised upon it in connection with other components which suggest *xma-kaba-kin* = "days without names." The so-called "nail-head" component of this glyph seems to have the phonetic value of *á*. It is absent, however, on the vase just referred to. In order to find out whether the *ch'i* glyph was used in other localities, a reference to Catherwood's drawing of the glyphs on the top of an altar at Copan, and various other sculptured tablets, indicates that it was used repeatedly by the Maya scribes. In one instance, at Copan, it recalls *Chikin*, the "west" or "sun-bitten." (Fig. 13).

The *ch'i* glyph has numerous variants, and seems to be accompanied by determinatives so as to indicate the vowel combinations, such as *chá*, *chā*, *ch'i*, *cho*, *chu*. We have called attention to a supposed determinative in a previous article published in *Science*, and one has already been referred to in this article. Where the glyph has no determinative whatever, as in Fig. 1, I accept it as *ch'*. If accompanied by the small circle, as in Fig. 2, I use it as *ch'i*. The sign of May orientation (Fig. 13), *Chikin*, the "west" or "sun-bitten," is an instance where this phonetic value has worked successfully. Where the *ch'i* glyph accompanied by two small circles (Fig. 15) placed on either of the tooth-like attachments (Fig. 16) which generally accompanies it, the phonetic value *ch'u* is suggested (see Figs. 4 and 5). Fig. 19 gives an admirable example of where two of the count-numerals are attached to the glyph; and, accepting it as a determinative, we obtain the phonetic value *ch'á*.

The *ch'i* glyph sometimes appears as shown in Fig. 18, and the resemblance of it to that of the day-sign, *manik* (Fig. 10), is striking. *Manik* has the same components,



only the outer line of the glyph encloses it completely, while in the *ch'i* glyyh the two ends of the pinching claw, or hand, are left open. Where it is closed we have a glyph formed, as in Fig. 20, which is not unlike the draughtsman's T-square, and seems to have the phonetic value *ma*. The T-square glyph (Fig. 20) is used at Palenque, small ventilators in the walls of one of the houses being shaped like it. At *Ch'i Ch'een-Itza* it appears as an ikonomatic decoration on the walls of a temple, and the small component (Fig. 11), so often used in the Maya glyphs, also appears as an ikonomatic decoration at *Ch'i*, *Ch'een*, *Itza*. Its phonetic

value seems to be *ich*, as an affix, and *chi* as a suffix. In Fig. 18 it is a prefix and reads *ich*, suggesting that *ch'i* is the proper phonetic value to be used. The determinatives that we have referred to in this and other articles seem to be phonetic.

Fig. 3 is the *U* of Landa, and there is reason to think that it is correct, for the *o* or *u* attached to it is divided in half by a line which I believe, from results obtained in other directions, is the vowel *o* with the cut-line through it. In the various *Ch'u* (or *Ch'o*) glyphs (Figs. 4 and 5) that we have given this component of the glyph is square (Fig. 16). It has the cut-sign in the middle, or is divided by it, and gives a fair representation of teeth. Co = tooth in Maya (pronounced Coo), and, as in Figs. 3, 4, 5, the cut-sign runs to the perpendicular line (Fig. 17), whose phonetic value in my alphabet = *H*, either end of the *h* glyph touching the *ch* glyph, which envelops it externally, as in Figs. 3, 4, I accept it as a suggestion of *h'* or *ch'u*

What we have designated as the cut-line, or sign, appears in other places. A good example is shown in Fig. 8. It is the well-known honey-sign, but in this case is combined with other glyphs. I act on a principle of analysis which so far has given good results, that the glyphs and Maya decorations are composed of ikonomatic components, and that the Maya scribe sculptor and his more demotic brethren do not seem to have used any meaningless decorations, either in their hieroglyphs or the ornamentation of their palaces, all these being in keeping with the words which they intended to convey to the reader's mind by the sound of the name of the thing represented. Fig. 8 is a glyph in the second row of the outer page of the Codex Troano. It is placed in front of Plate 35 of Brasseur's work. We will begin our analysis as follows: (*a*) The upper, left-hand glyph and the determinative sign below it on the lower, left-hand side; (*b*) the upper, right-hand glyph and the honey-sign below it at the lower, right-hand side. The *o* or *u* glyph is composed of the eye glyph, *ich*, or *uich*, placed on either side below the tooth-like appendage, *Co*. Just above it, in the elongated,oval glyph, is the *há* or *h* glyph, a line running through *o* or *u*, these two glyphs giving us an admirable suggestion of *ch'u* or *ch'o*. By taking half of this upper glyph it can easily be seen that the *u* of Landa (Fig. 3) is but a variant of this glyph (Fig. 21). The upper right-hand glyph (Fig. 8) has the dotted *sh* aspirate, together with the *i* loop and *l* curve. Descending from the *i* loop is the twisted glyph (or line), whose phonetic value I have so far used with success as *ba* (from *ba*, twisted, tortuous, bent). By trying every combination that can be obtained from this glyph and the preceding glyphs, I find that the following word was probably that intended by the Maya scribe, viz., "ch'u-h-oo-sh-il," or "ch'hucil." Turning to the vocabulary of Brasseur, which seems to suit this kind of work better than the dictionary of Perez, I find that the word in Maya means "sweets." This placed over the honey-sign, at the lower right-hand corner, indicates that we are not far astray in our analysis. The honey-sign has the two small, square, black, count glyphs attached to its left upper and lower corners = *ca*, or "two;" next comes our dotted aspirate line, which has the phonetic value *sh* or *x*; beyond this aspirate, to the left, is the *hd* or *h*, a perpendicular line, giving us in connection with the other components and the aspirate "ca-há" (*b* is understood) = *cab*, or "honey." "Sweets-honey" is, I think, a fair interpretation of this glyph, which anyone who has studied the "Bee-Keeper's *Narrative*" of the Troano will recall as intimately associated with honey and the honey-comb. Its component, *il*, is the antennæ of the bee, with the *i* loop attached.

This antennæ glyph I have shown in a previous article to be intimately associated with the honey sign *Cab*.

The second *u* of Landa's alphabet (Fig. 14) is expressed by the *o* and *u* and the *l* curve to which the twisted glyph, *ba*, is attached. This gives us "Ho-ba;" and the aspirate of Landa, marked by the indented curve between the *il* and *ba* components of this sign, changes the *bd* into *hd* or *yd*, giving us "Ho-ya" = "to water," "sprinkle." The *u* of Landa is often seen placed below the hieroglyph of the firmament, and is intimately connected with *há*, or "water which refreshes the earth with rain," "dew and moisture." *Ca*, *hd*, *o*, *u* have an interesting relation with the *ch'i* glyph, and, from what we have related, seem to be determinatives.

The *ch'i* glyph is represented in many different parts of the Troano either as the claw-like appendage of the shell fish, as in Plate 24 (*b*), Codex Troano, the centipede or tarantula claw, as in Plate 13 ,Troano (*b.c.*), Plate 18 (*b*). Plate 9 (*c*), or as the "pinching hand," with its crustacean like thumb on Plate 25 (*b*), Troano.

DEATH OF PROFESSOR W. P. TROWBRIDGE.

PROFESSOR WILLIAM P. TROWBRIDGE, the head of the engineering department of the Columbia College School of Mines, died of heart-failure at his home in New Haven last Friday. He was born in Troy, Oakland County, Mich., May 25, 1828, and entered the West Point Military Academy in 1844, where he graduated four years later, receiving an appointment as second-lieutenant in the corps of engineers. He had served as Assistant Professor of Chemistry during the last year of his course at the academy, and after his graduation he was occupied for some time with astronomical work at the West Point Observatory. In 1851 he was appointed to a position on the Coast Survey under Superintendent Bache, which he held till 1856, and at a later time he took part in the survey of the James and Appomattox Rivers and in a series of surveys on the Pacific coast.

In 1854 he had received a commission as first-lieutenant in the U. S. Army, which he resigned two years later to accept the professorship of mathematics in the University of Michigan; but after a year of service, he resigned his professorship also, and was appointed scientific secretary to the superintendent of the Coast Survey. During the Civil War he again served in the army, and rose to the rank of brigadier-general; his work in the army being largely in connection with fortifications in New York harbor and elsewhere.

After the war was over he resigned his commission again, and entered the Sheffield Scientific School of Yale College as Professor of Dynamic Engineering, but resigned in 1877 to take the professorship of engineering at Columbia, which, as we have stated, he held up to the time of his death.

Professor Trowbridge was the author of a treatise on "Heat as a Source of Power" and several other works on engineering subjects. He was the chief agent of the tenth census for collecting statistics relating to power and machinery employed in manufactures. He was for four years Adjutant-General of Connecticut, was Vice-President of the New York Academy of Sciences and of the American Association for the Advancement of Science, and was a fellow of the National Academy of Sciences. For several years Professor Trowbridge was a director of the Science Company.

NOTES AND NEWS.

THE question whether an attack of influenza confers protection from subsequent infection is one which must have often arisen during the experiences of the last three years, but the data for its solution are not yet fully available. The amount of information which must have been gleaned by the family practitioner in all parts of the country upon this and many other points concerning the malady would, if collated, go far to settle the matter. It is of course notorious that certain individuals have suffered from more than one attack; but the conviction is pretty general that such cases really form but a small minority of the large numbers who have suffered. Then, again, it must be deemed possible that the degree and duration of the protection may depend on the severity which the primary attack exhibited, for one can hardly invoke the doctrine of attenuation of virus in the case of this disease, which shows so much variation from the ordinary course of infective disorders in general. In a highly interesting contribution upon the features of the present epidemic in Berlin, according to *Lancet*, Dr. Ruhemann directs especial attention to this question of protection and affords valuable evidence of it. He aptly remarks that the more gradual evolution and persistent character of the present epidemic, as compared with the rapid and stormy course of the pandemic of 1889 to 1890, have afforded opportunity for more closely studying the character of the malady, and that it has especially enabled us to recognize more clearly its contagious nature. According to him, influenza has prevailed in Berlin ever since the beginning of last September, and he notes how on this occasion the stress of the outbreak had fallen to a far greater extent upon women and children and less upon men than was the case two years ago. His own practice affords proof of this, especially in the fact of the greater frequency of uncomplicated cases among women than among men. As to the question of protection, he has observed that members of families who were severely attacked two years ago have either escaped entirely at present or been only slightly affected; whilst, conversely, the most serious cases of the present time have arisen in households which the influenza spared during its earlier visitation. He notes the statement of Dr. Edward Gray, to the effect that "many persons who escaped the epidemic of 1775 were affected by that of 1782, and many who escaped the latter were affected by the former," as showing that a century ago this question of immunity had not passed unnoticed. Dr. Ruhemann gives his experience of 55 families, numbering 193 individuals. In 1889-90 there were 64 cases of influenza among this group, whilst in the present outbreak only 40 have been attacked, and, what is of special interest, only 5 out of this number were affected (and that but slightly) two years ago, whilst of the 64 then attacked only 4 have again become victims. Should this prove to be anything like the general experience it would go far to substantiate a fact that has hitherto been much disputed, even to the extent of declaring that one attack predisposes to another. That one individual may have several recurrences during the prevalence of a single epidemic does not, in Dr. Ruhemann's opinion, mitigate against the general doctrine of protection, since he thinks many such recurrences may be explained by lack of caution on the part of the patients against exposing themselves to fresh infection before they are restored to full health. That influenza does protect from a second infection should reassure many persons who, having once suffered severely from it, dread a repetition of so depressing a malady, and it may be further comfort to them to learn that the more they have to suffer at first, the less likely are they to suffer at all again. If, then, influenza shares this common property of all infective diseases, it is not so remarkable that it should not apparently select the young in preference to the adult and aged, seeing that the whole community is more or less "unprotected" when it first reappears after an absence (in pandemic form) of years.

— At the meeting of the Gesellschaft Deutscher Naturforscher und Aerzte held last year in Halle, it was arranged that the sixty-fifth meeting should be held this year at Nürnberg, from the 12th to the 16th of September. This society, similar to the English and American associations for the advancement of science, together with a medical association, is divided into thirty-two sections, about two-thirds of which belong to the medical side, and the remaining are scientific, if it be allowed to use the word in the narrow sense. The three general sittings are to be opened by addresses from Professors His of Leipzig, von Helmholtz of Berlin, and Günther of Munich respectively; and in the meetings of the sections — for example, in chemistry — papers will be read, among others, by Ostwald and E. v. Meyer; in physics by Wiedemann and Boltzmann; in mathematics by G. Cantor, F. Klein and Königsberger. On one of the days of the meeting excursions are to be made by certain of the sections. Those of physics and zoology and some of the medicinal sections go to Erlangen, where the apparatus of the University laboratories will be used in demonstration of papers. On the same day the sections of botany, mineralogy, and geology, ethnology, and anthropology make a scientific excursion to Neuhaus or Pommelsbrunn. As before, the German Mathematical Society meets with the general Science Society, and thus the number of papers in the section of mathematics is probably larger than in any other section. There is to be a technical industrial exhibition in charge of the general society and the Bavarian government, and the Mathematical Society has undertaken an exhibition of "mathematical models, drawings, apparatus, and instruments, serving both for teaching and research in pure and applied mathematics." This latter exhibition is to include only those instruments having an interest primarily mathematical, while the instruments having to do with the experimental sciences, and of more practical use, are to be placed in the general exhibition, which will be especially rich historically, as the collections of the Nürnberg Industrial Museum are to be utilized. The mathematical exhibition is to include historical surface and curve models, such as those constructed by Plücker and Klein, and later those of the Brill collection; and certain unique models which have been in university collections, and which have become dilapidated, are to be as much as possible re-set. In connection with these models explanitory lectures are to be delivered, those thus far announced being as follows: Dyck, introductory lecture on the mathematical exhibition; Bjerknes, hydrodynamic phenomena analogous to electric and magnetic; Finsterwalder, surface curvature; Mehmke, reckoning machines. Other lectures are to be given on function-theory surfaces, etc. In this connection it is of interest to note that Professor Klein, who probably exerts the most influence in the German Mathematical Society, and who is a member of the mathematical advisory committee of the Chicago exhibition, suggests that such an exhibition of models with demonstrations be introduced there.

— For some eight years the theory has been before the scientific world that the great ice-sheet bridged the Ohio River near Cincinnati, Ohio, sufficiently to block its channel and raise the waters above the place of bridging to a height of 500 to 600 feet above the present river-bed. Silt deposits east of Cincinnati near the ice margin have been cited as evidence of this dam since they stand about 600 feet above the Ohio. These silts have been found by Frank Leverett, U. S. Geological Survey, Madison, Wis., to be too widespread to admit of this explanation, since they extend west past Cincinnati, covering much of southern Indiana as well as portions of States farther west. They are also of later date, since they rest upon the drift deposited by the ice when it bridged the Ohio, and are separated from it by a considerable time-interval, shown by humus stain, leaching of till, and erosion of surface of the underlying drift. The apparent absence of striæ south of the Ohio River and the meagre amount of drift there indicate a thin ice-sheet with feeble movement. These facts and a comparison with other districts where conditions for damming appear to have been more favorable than on the Ohio, lead to the conclusion that the river would not be blocked except for very brief periods.

— *Neptunia*, May, 1892, reports a singular phenomenon from the Balearic Isles. On March 4, about 9 o'clock in the morning, a violent wind from the north blew over Soller in Majorca. As the wind died away, the rain by which it was accompanied increased, and at the same time the ground was covered by a yellowish coating, which proved to be sulphur.

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THE AMERICAN PSYCHOLOGICAL ASSOCIATION.

IN response to an invitation issued by President G. Stanley Hall of Clark University, a preliminary meeting of psychologists from various institutions was held at that university, Worcester, Mass., on July 8.

The meeting was presided over by Professor G. S. Fullerton of the University of Pennsylvania. After a general expression of opinion as to the form of organization, it was determined to refer the entire matter to a committee consisting of President Hall of Clark University, Professor Fullerton of the University of Pennsylvania, Professor Jastrow of the University of Wisconsin, Professor James of Harvard University, Professor Ladd of Yale University, Professor Cattell of Columbia College, Professor Baldwin of the University of Toronto.

This committee was authorized to determine the place, time, and programme for the next meeting and then to report a plan of organization.

It was the sense of those present that these gentlemen should constitute a council to be renewed by frequent elections and should choose from their own number an executive committee to direct the more urgent affairs of the association, and that the first three gentlemen named should act temporarily as such committee.

Sessions were held in the afternoon and evening, at which papers were read by Professors Jastrow, Sanford, and Bryan, and Doctors Nichols, Krohn, and Gilman. It was decided in response to an invitation from Professor Fullerton to hold the next meeting of the association in Philadelphia, at the University of Pennsylvania, on Tuesday, Dec. 27, at 10 A.M.

Professor Jastrow was appointed secretary to provide a programme for that meeting. He invites all members to submit to him at Madison, Wisconsin, titles of papers with brief abstracts and estimates of time required for presentation.

The original members who were either present at this meeting or sent letters of approval and accepted membership, are as follows: Frank Angell, Leland Stanford, Jr., University; J. Mark Baldwin, Toronto University; W. L. Bryan, Indiana University; W. H. Burnham, Clark University; J. McK. Cattell, Columbia College; Edward Cowles, McLean Asylum; E. B. Delabarre, Brown University; John Dewey, University of Michigan; G. S. Fullerton, University of Pennsylvania; E. H. Griffin, Clark University; G. Stanley Hall, Clark University; J. G. Hume, Toronto University; J. H. Hyslop, Columbia College; William James, Harvard University; Joseph Jastrow, University of Wisconsin; W. O. Krohn, Clark University; G. T. Ladd, Yale University; Herbert Nichols, Harvard University; William Noyes, McLean Asylum; G. T. W. Patrick, University of Iowa; Josiah Royce, Harvard University; E. C. Sanford, Clark University; E. W. Scripture, Yale University; Lightmer Witmer, University of Pennsylvania; H. K. Wolfe, University of Nebraska.

The following additional members were elected: Dr. T. Wesley Mills, McGill College, Montreal; Hugo Münsterberg, Harvard University; A. T. Ormond, Princeton College; Edward Pace, Catholic University, Washington; E. B. Titchener, Cornell University.

Professor Jastrow asked the co-operation of all members for the section of psychology at the World's Fair, and invites correspondence upon the matter.

THE PEST OF FIELD-MICE IN THESSALY AND LOEFFLER'S SUCCESSFUL METHOD OF COMBATING IT.[1]

BY MEADE BOLTON.

THE valley of Thessaly was recently threatened with entire destruction of its growing crops by swarms of field-mice, which had suddenly appeared in such alarming numbers that the farmers and the government were at their wits' ends to discover efficient means to combat the pest. Several different poisons were tried at public expense, and it was also attempted to drown the mice out in some places; but owing to the difficulties of application and the inefficiency of these methods, it was found greatly desirable to look for other means. Pasteur was applied to by one of the large landowners for cultures of some microbe which could be used to destroy the mice, and Pasteur promptly referred his correspondent to Loeffler in Greifswald, who had discovered a bacillus which would answer the purpose. Pasteur's answer was sent to the government at Athens, and as the attention of the government had already been called to Loeffler's work by the Grecian ambassador at Berlin, Loeffler was requested to send cultures to be used in the infested districts. Fearing that the tests would not be made in such a manner as to secure success, Loeffler informed the Grecian ambassador, that, although he was willing to give the cultures, he would prefer to make the experiment himself, provided his expenses were paid.

On April 1 Loeffler received notice that if he would come the Grecian government was willing to pay his expenses and those of an assistant. So, after being informed that the mice were of the kind[2] that he had found susceptible to infection with his bacillus, Loeffler and his assistant, Dr. Abel, set out with a supply of cultures on April 5 from Berlin, and arrived in Athens April 9. On going to the pathological laboratory he was shown some of the mice from Thessaly, and to his chagrin he found they differed from the

[1] Centralblatt für Bacteriologie und Parasitenkunde Bd. XII., No. 1.

[2] Arvicola arvalis.

kind he had worked on at home. Fortunately, however, it was found that the mice at Athens were even more susceptible to inoculation and also to infection through the alimentary canal than those in Germany. This fact was established in a few days by inoculating and feeding the mice in the laboratory with cultures of the organism. Preparations for experiment on a large scale were at once made, and Loeffler, Dr. Abel, and Dr. Pampoukis, director of the bacteriological laboratory in Athens, set sail on April 16 for Volo, and went by rail from thence to Larissa, the capital of Thessaly.

Loeffler had found that the micro-organism, Bacillus typhi murium,[1] grows very well in a decoction of oat and barley straw to which 1 per cent of peptone and ½ per cent of grape sugar have been added. So a large amount of this liquid was prepared and inoculated. Pieces of bread about the size of a finger were soaked in these cultures after abundant growth was secured, and the bread was then distributed in the openings of the burrows of the mice. A number of mice were also inoculated and turned loose; this was done because the mice eat the bodies of those that die, and spread contagion in this way. It had been amply proved by experiment that the bread soaked in the culture could be eaten by man and various domestic animals with perfect impunity.

In a few days after the holes had been baited, news came from all sides that the infected bread had disappeared from the holes. This news was very satisfactory, as it could by no means be certainly counted upon beforehand that the mice would eat the bread, surrounded as they were with abundance of fresh food. A visit to Bakrena, about nine days after the experiment had been started at that place, showed that the mice had ceased their activity entirely. In two other places, Nochali and Amarlar, a similar result was obtained. Several burrows at these places were opened and found to be empty or to contain sick, dead, or half-eaten mice. There were sick and dying mice sticking in many of the openings. A number of sick and dead mice were carried to Larissa, and examined. They were found to present all the characteristic lesions of the typhoid fever of mice, and to contain the organism in their internal organs.

Reports from other places which Loeffler subsequently received, were all satisfactory. So Loeffler is justified in closing his very interesting account of his expedition with the following words: "The science of bacteriology has thus again proved its great practical significance, and hence also its right to be specially cultivated and advanced."

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Ancient Libyan Alphabet.

IN *Science*, Aug. 12, Professor Keane offers some inquiries and statements relating to a note of mine on the Libyan alphabet.

The note referred to was partly based on an article by Dr. Collignon, as was indicated. Dr. Collignon is one of the highest authorities living on north African ethnography and archæology, as Professor Keane doubtless knows. He would not make the following statement unless he had good grounds for it: "Quant à la forme même des caractères libyques, on ne peut nier qu'elle ne remonte à une haute antiquité; *elle est, en tout cas, antérieure à Carthage.*" Of course, Dr. Collignon is aware of the common theory that the letters were of Punic origin; but considers it time to discard it.

As to Professor Keane's suggession of the origin of the name *tifinar*, from *Finagh* = Phœnician, it is purely fanciful, and his assertion that the stress "still falls on the root *fin*," is utterly incorrect, as it falls on the last syllable, and not on the penult (see Hanoteau, "Grammaire Tamachek," p. 5).

It is true that in loose language the whole alphabet, or any alphabet, is called *tifinar;* and it is not quite correct to say that all the *tiddebakin* are vowels. The proper distinction is thus given: "Les signes exclusivement tracés en *traits* sont nommés *tifinar;* ceux tracés avec des *points* sont nommés *tiddebakin.*"

How Professor Keane, quoting Hanoteau's "Grammaire Tamachek," can deliberately write that in the Libyan alphabet "curves occur quite as frequently as straight lines," can only be explained by the supposition that he never saw the book he quotes. It is before me now, and out of the thirty-five simple and compound letters only three are curvilinear, and all of these are recognized as mere variants, and placed after the true rectilinear forms. I refuse to think that this is a fair example of the accuracy of Professor Keane's quotations.

Whether they were derived from a rectangle or not, has something more than theoretical importance in relation to their possible derivation from Egyptian forms; but it need not be insisted on. That all the original forms were composed of right lines is a point of considerable interest, which has not been disproved.

As to what writers may be considered specialists in the study, there is room for legitimate difference of opinion. When Professor Keane rejects Duveyrier, he rejects the author who beyond all others has a practical acquaintance with the written speech of the Touaregs — the only tribe who still use the tifinar. Professor Newman's works have been laid aside as substantially useless, on account of their phonetic system, by the best French scholars — notably René Basset; and Dr. Oudney never claimed to be an adept in the tongue.

D. G. BRINTON.

Media, Pa., Aug. 15.

Remarks on the Migration of Coleopters.

ONE might suppose, on simply looking at the map of the earth, that the animals of the northern hemisphere would exhibit a greater structural uniformity than those south of the equator.

In the north the continents on one side are separated only by the narrow Behring's Strait, on the other the Gulf Stream, and the prevailing west-east storms connect both continents, making migration of insects a possibility.

The similarity of climates of the northern half of the continents is less favorable to the production of generic varieties than are the southern lands, isolated by wide troughs of the ocean, with a variety of climes and altitudes; and, indeed, as we go northwards the varieties decrease in number.

If we abstract from the coleopterous groups genera which are most likely to migrate from one continent to the other by commerce, such as the Staphilinidæ, the Silphidæ, or the phytophagous insects, transportable in their food-plants, the rest of the forms will represent the aboriginal masses of 400 years ago.

In the far north above latitude 50°, and where Asia approaches so near to the American shores, the indigenous genera of both continents differ comparatively little; the genera are common, and some species are identical in both continents. Commerce in these regions was slight, even up to our days, and an uninterrupted natural development manifests itself everywhere.

True northern genera, such as the Carabus, Calosoma, and Cychrus, have species of strict similarity, such as Calosoma sycophanta, indagator, etc., extending from the Atlantic to the Pacific in the eastern continent, and Cal. scrutator, calidum, and wilcoxii in America; Carabus cancellatus, clathratus, and monilis on one side, Car. serratus, limbatus, and vinctus on the other, and Car. truncaticollis on both sides of Behring Sea.

If we assume that the land holding the greater number of species of one genus constitutes a centre of development, that is the birthplace of that genus. Accordingly, the genera Cychrus and Calosoma are to be taken as of American origin; the first being represented in Europe and Asia by four and in America by thirty species, the

[1] Centralblatt f. Bacteriologie und Parasitenkunde Bd. IX., No. 5.

latter in Europe by about half a dozen and in America by twenty-five species; while Carabus is represented in Europe and Asia by the respectable number of 100, and in America by a short dozen species.

My favorite family of Poelaphidæ, unlike their relatives, the Staphilinidæ, seem not very apt to migrate on the lines of commerce, but extend over a space of 60° latitude north and south.

In the colder regions of the north the species of one genus inhabiting both continents are very similar, while the tropical and southern genera, with a comparatively small number of species, differ in form so much that they can hardly be retained under one name.

Their habits, which suffer an involuntary modification by transportation through atmospheric forces into localities of different nature, produced in the fittest to survive changes of the most grotesque forms, and by repeated dislocations confined them in circumscribed localities.

This holds good for the tropical forms of this family in the large continents; but there are examples of genera occurring in places far apart. Tmesiphorus, Tyrus, and Hamotus are of that nature. To the latter belong Upulona raffray and Cercocerus lecoate, which differ, according to M. Raffray, by the more elongated form of the last joint of the maxillary palpi in Cercocerus, and the former occurs in the Friendly Islands, and the latter, together with the rest of Hamotus, is found in the western regions and on the Pacific coast of America, north and south.

The streams of the Pacific Ocean are directed from west to east, and therefore would not allow a migration against the stream; consequently the original abode of those species must have been situated in the west of America, and their migration, considering the multiplication of forms in America, must date back to the remotest ages.

The Tenebrionidæ present a typical family of non-migrating beetles. The large majority of tenebrionide genera are wingless. They are slow in motion, and live on dead animal and vegetable matter. The generic forms of most of those in America are but distantly related to those of the eastern continent. The genera common to both continents are few, and the few immigrant species are winged, with one exception recently found — Blaps mortiraga — and such genera, which are at present assumed to be common to both lands (as Asida), owe their name to the now accepted basis of analytical marks.

The existence of these analogical forms can be explained only by the different geological and geographical conditions of the surface of the earth in remote ages. But there is always to be considered the axiom that similar conditions produce similar forms.

EMIL BRENDEL.

Cause of a National Trait.

IT is a matter of common observation that Hebrews, as a rule, are more than ordinarily devoted to their families, and their home-life is beautiful in many ways. As everything has a cause, the most plausible one in this regard appears to me to be the severe persecutions to which that race has been subjected for centuries, compelling clannishness and affording them their greatest happiness at home. Persistent influences acting through numberless generations would surely institute a racial peculiarity such as this.

S. V. CLEVENGER.

Chicago, Aug. 15.

Review of some Recent Publications of the U. S. National Museum.

FOR some time past the National Museum has been following the very desirable plan of issuing, in separate pamphlet form, the contributions of those authors who publish in the Proceedings or other reports of that institution. These pamphlets are uniformly contained in neat paper-covers, tasteful in color, and bear upon the outside page the title and author of the article and its number, from what standard publication of the Museum extracted, and, finally, the volume, pages, and plates (if any) of the latter. It would be well, indeed, if other institutions and societies always followed suit in these last two features, for if one thing be more annoying than another to a worker in science with a working library, it is to receive reprints of papers that bear nowhere upon them this very important information; especially when an author desires to quote from reprints that have been submitted to him. At this date the Museum has issued a number of pamphlets of the character to which the attention of the reader has just been drawn, and it is believed that brief remarks upon these may prove to be of interest.

In No. 898 Mrs. M Burton Williamson gives "An Annotated List of the Shells of San Pedro Bay and Vicinity," in which two new species are described by W. H. Dall. This list is brought quite up to date, carefully describes a great many species, is systematically arranged, and is illustrated by 38 excellent figures on plates. It will, no doubt, prove of use and value to the conchologists of the Pacific coast and elsewhere. Dr. Edwin Linton, in No. 893, gives some very full and valuable "Notes on Avian Entozoa," illustrated by nearly 100 figures of structural details. Entozoa found in specimens of *Larus californicus*, *Fuligula vallisneria*, *Oedemia americana*, and *Pelecanus erythrorhynchus* are described, in addition to parasites found in other birds collected by Mr. P. L. Jouy at Guaymas, Mexico. "One new genus was met with among the parasites of the duck, *Oedemia americana*. This genus, which I have named *Epision*, is characterized by a singular modification of the anterior part of the body into an organ for absorption and adhesion." In a brief paper, entitled "A Maid of Wolpai," with one plate, Dr. R. W. Shufeldt gives an account of the customs and dress of the young women of that Pueblo (No. 889); and the same writer, in another paper (No. 902) entitled "The Evolution of House Building among the Navajo Indians," describes the gradual improvement observed by him in the building of their houses by those Indians in New Mexico, since their contact with the whites The paper is accompanied by three plates illustrating the subject. Lieut. T. Dix Bolles of the navy comments briefly on "Chinese Relics in Alaska" (No. 899, one plate), and from his studies of them he is forced to believe that at least two centuries ago a Chinese junk must have been driven upon the Alaskan coast. A very useful paper is that by Mary J. Rathbun, giving a "Catalogue of the Crabs of the Family Periceridæ in the U. S National Museum" (No. 901), and it is illustrated by numerous figures of various species of that group Papers of this class are especially desirable, and at the time of its appearance there were to be found in the collections of the Museum 48 species of *Periceridæ*, for which a valuable synonomy is given, with a "Key" to genera and species. Akin to this last is still another beautifully illustrated paper by Mr. James E. Benedict, on "Corystoid Crabs of the genera Telmessus and Erimacrus." Very little is known of these forms, and the writer's article is based on specimens collected in Alaska by Dall, and on the *Albatross* collections (No. 900). No less interesting are two admirable papers by Dr. Leonhard Stejneger, both of which are illustrated (Nos. 894, 904). The first gives a "Preliminary description of a new Genus and Species of Blind Cave Salamander from North America,"— a remarkable form from the Rock House Cave, Missouri. "A new genus and species of salamander may not be such a startling novelty even at this late date, but the interest is considerably heightened when we have to do with the first and only blind form among the true salamanders." It has been named by the author *Typhlotriton spelæus*. Dr. Stejneger's second paper is of considerable length, presenting, as it does, extensive "Notes on a Collection of Birds made by Harry V. Henson in the Island of Yeso, Japan." It contains many excellent embryological plates. Professor Carl H. Eigenmann, in No. 897, makes a contribution to the study of "The Fishes of San Diego," in which "especial attention has been paid to the spawning habits and seasons, the embryology, and migration of the fishes of Southern California." The paper is of great economic value, and lacks not in interest to the anatomist.

Finally, we have three very thorough entomological articles from the pen of Dr. John B. Smith (Nos. 890–892). They deal with a "Revision of the Genus Cucullia; Revision of the Dicopinæ; Revision of Xylomiges and Morrisonia" (plates II., III.). These contributions will be welcomed by the entomologist, fully

setting forth, as they do, characterizations of the several genera and species to which the author has given his attention.

R. W. SHUFELDT.

Takoma, D. C., Aug. 15.

The Color of the Blood in Man.

HAVING recently examined a large number of specimens of human blood from persons of different ages ranging from four to seventy-six years, some being those in robust health, others being tuberculous, I was struck with the great difference in the shade of color presented, some being of a very rich tint, others very pale. The richest color was in the blood of a girl twenty-six years of age, a graduate of Vassar College, who had the highest anthropometric measurement for respiratory capacity in a class of about 500 girls. Her health was excellent, and she consumed rather more flesh-food than is usual. The next highest tint was found in the blood of a woman about seventy years old, with a somewhat unusual chest measurement, having also excellent respiratory capacity and being in fine health. This woman, on the contrary, does not eat flesh at all. I expected in her case to find a more than ordinary number of white blood corpuscles; but there were far less than usual, it being difficult to find them, they were so few. The palest blood was from a chlorotic Irish servant-girl of twenty-five years, and in a tuberculous boy of four. There was not much perceptible difference in their cases. The girl had naturally good respiratory power, but she had lessened it by tight clothing and an almost constant in-door life for a long time. After spending a month at the seaside, I examined her blood again, and found the tint somewhat deeper than before. As we know, the color of the blood is caused by the hæmoglobin in the red blood corpuscles, and if this is greater when the respiratory capacity is greatest, may not the color of the blood be heightened by enlarging the chest and increasing the lung-power? From some observations I have made I believe it can.

M. L. HOLBROOK.

New York, Aug. 16.

Snake Eats Snake.

WHILE walking over a dry mesa, yesterday, I noticed a small snake slowly crawling to the shelter of a mesquit bush. On capturing it, I found it to be of a very dark olive-green color, in large, square pattern, the lines between the plaids being of lighter green; underneath, white, with very dark-green blotches. Its head was very dark green, and rather small; it had small fangs. The length of the snake was nineteen inches. Noticing that the body seemed much distended, I opened it, and found, nicely packed away inside, the body of an ordinary, brown, striped "grass snake," as we call them here, twenty-two inches long. This green snake may be a new species of snake-eating serpent. The grass snake is very swift, and I am puzzled to know how the green snake caught it; it was swallowed head-first.

C. W. KEMPTON.

Oro Blanco, Arizona, Aug. 8.

Cleistogamy in the Pansy.

MR. DARWIN, in "Forms of Flowers," notes that, though cleistogamy is the rule in the genus *Viola*, the pansy, *Viola tricolor*, has not been known to exhibit it, though it does sometimes produce very small and closed self-fertilizing flowers, which would critically be termed cleistogamic if some portions of the floral organs were to abort. In our country this condition may more readily occur than in the Old World. In many localities the pansy has become partially wild and cleistogamy may be looked for. Mr. Chalkley Palmer has sent me some specimens in fruit, found wild in some place in New Jersey, which are certainly in one or the other condition noted by Mr. Darwin. They appear to be truly cleistogamic, but were too far advanced to determine with accuracy.

THOMAS MEEHAN.

Germantown, Pa.

BOOK-REVIEWS.

Annual Report of the Geological Survey of Arkansas for 1890. Vol. III. *Whetstones and the Novaculites of Arkansas* By L. S. GRISWOLD. Little Rock, Arkansas.

THE history of the rise and progress of geology in the United States remains to be written. It dates back to early in the century; for in 1807 McClure published a paper containing geological observations. Mitchell, Eaton, Dewey, Silliman, and hosts of others followed one another in rapid succession. Nor were the observations of private individuals all that appeared in the early decades, for in 1823 Olmsted published a report on the geology of North Carolina, as one result of a regularly organized State survey, while Hitchcock in 1831 reported upon the geology of Massachusetts. Between that date and 1840 State surveys had been organized and reports had been published in Maine, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Georgia, Tennessee, Kentucky, Ohio, Indiana, and Michigan. The general government, too, had sent expeditions to the north-west, Schoolcraft reporting upon the Michigan region as early as 1820. It is true that many of the State surveys ceased after the issuance of a few documents, but their existence even for a brief period was evidence of the belief in their value. Some of the States organized second surveys at a later date and published numerous volumes among which New Jersey, Pennsylvania, Ohio, and Kentucky are especially to be noted. The survey of New York has been continued from 1837 until the present time.

In those olden times the State survey reports were general; observations were made over an extended area; profuse details were given of township or county geology; but no one subject was treated in an exhaustive manner. The result was that, when ten or a dozen or more volumes had been published, it still remained to collate and epitomize the information. For the States of New York, Pennsylvania,[1] Kentucky, Ohio, Illinois and others this has never been done, and the numerous volumes of these surveys are masses of details with full and comprehensive accounts of scarcely a single subject. Dr. Branner, as the State Geologist of Arkansas, has seen fit to change this ancient order of things, and as a result in his annual reports we have volumes describing the Mesozoic geology, the gold and silver fields, and the coal of the State, as well as exhaustive volumes on Manganese and the Novaculites. The first geological survey of Arkansas published two reports, in 1859 and 1860. The beginning of the war put a stop to the work, however, and it was not until 1888 that any further work in the State was published. The report for that year, and those for 1889 and 1890, of which the volume under review is the third, contain much information valuable alike to the State and to the world at large.

Whetting, or sharpening, is one of the ancient arts. That it was practised by early civilized man is evidenced by the existence in the Sanscrit of the word *ça*, meaning to sharpen or whet. From this comes the Latin *cos*, a whetstone, hone or flint-stone, and hence *cotaria*, a whetstone quarry. *Coticula*, meaning a small touch-stone, is also a derivative, and from this comes the French *coticule*, meaning a whetstone of a fine quality. *Novaculite* comes from *novacula*, a sharp knife or razor, and this in turn is derived from the Latin *novare*, to renew or to make fresh.

Many writers from Pliny down discuss whetstones or hones for sharpening tools. Linnæus used the word *novacula* in his time, and it was seemingly anglicized by Richard Kirwan into *novaculite* in 1784. Mr. Griswold believes, although all mineralogists do not agree with him,[2] that it is practicable "to revive the word as a scientific term, in its original sense, to denote a fine-grained, gritty, homogeneous, and highly siliceous rock, translucent on thin edges, and having a conchoidal or sub-conchoidal fracture. If this definition is strictly adhered to, no confusion will arise from the use of the word in commerce" (p. 18).

The knowledge of whetstones in America dates from 1818, when they were mentioned by Bringier as occurring in Arkansas.

[1] Professor J. L. Lesley is now engaged on this work, and Vol. I. of his final report has appeared.

[2] For example, G. P. Merrill in Annual Report U. S. Nat. Mus. for 1890, 1892, p. 525.

Since then they have been found in many parts of the country, no less than 106 localities being now known whence they have been obtained. All of these localities are naturally not equally good, and many of them are not now worked at all.

Some useful hints are given by Mr. Griswold in Chapter iv. on the purchase and care of whetstones. and especially that little-understood matter, the use of lubricants; and in Chapter v. the subject of manufacture of stones is discussed. This dates back to the beginning of the Christian era at least, for definitely-shaped hones are found at Pompeii. At present, in America, the stones mostly come from Indiana, Arkansas, New Hampshire, and Vermont; although there are other States producing them. The total out-put is small, and $75,000 would represent the value of the manufactured product in 1880.

Of the Arkansas stone proper, considered a typical novaculite, only about 60,000 pounds are quarried annually. The most of this goes to New York to be manufactured, whence it is largely shipped back to Arkansas. The blocks are laid in plaster of Paris in the bed of the gang-saw, and the saws are so arranged as to waste as little as possible. The sawing is slow, "saws going at the rate of 80 swings per minute will only penetrate the stone in the gang-bed at the rate of 1¼ inches in 10 hours. Marble is sometimes sawed at a rate of nearly 8 inches per hour, though for dense marble 2 inches per hour is a closer estimate." After the first cutting the slabs are sorted, and the useless pieces thrown away, this being done again and again as the pieces are reduced in size until only 25 per cent of the original amount remains as a marketable product. Of the Ouachita stone, a coarser variety of whetstone, a much larger amount is produced, this being in 1889 1,040,000 pounds. The method of cutting is about the same as for the Arkansas stone, while the waste is about 50 per cent.

Mr. Griswold deals extensively with the petrography of the novaculites, giving descriptions of numerous microscopic sections from various localities. The conclusions may be summed up as follows: Novaculite rocks were deposited in deep water as sediments, the carbonate of lime crystallizing as rhombohedrons. Consolidation of the siliceous portions produced a hard, brittle rock, which, being subsequently folded and elevated above the sea-level, was subjected to erosion. During this process the calcite crystals were removed, and subsequently a secondary deposit of silica took place.

In regard to the sedimentary origin of the rocks, Mr. Griswold says: —

"It may be somewhat difficult to conceive of a constant supply of very fine fragmental silica, almost totally without other materials, in sufficient quantity to form beds several feet in thickness with very thin layers of slate between, and making a formation from 500 to 600 feet in thickness, yet this seems to have been the manner in which these rocks were formed. After all, the conception is not so difficult when one considers that the fragmental silica of many of the slates and shales is as fine as that of novaculite, and as the percentage of silica in the sediments forming these rocks is increased, the resulting rock approaches more and more closely the novaculite. Thus with the novaculites are associated very argillaceous shales, grading into siliceous shales and then into transparent novaculites. The almost absolute purity of the novaculites still causes doubt as to the possibility of this mode of origin; but many coarse sandstones are nearly as pure, and if the novaculites can be considered as extensions of the sandstones toward the deep sea, where the finer fragments would settle, then we have at least a close approximation to the sediments forming the novaculites. That the same action which produces the angular fragments of quartz in sandstones must also afford a very large amount of exceedingly fine quartz is evident" (p. 192).

Many pages of the report are devoted to details of the geology of the novaculite area, but it is obviously impossible to enter into any of these here. A brief epitome only can be given of the geological history of the area, which in Mr. Griswold's words is as follows: —

"The sequence of events in this history seems to have been as follows: A deposition of very fine fragmental material on the deep-sea floor to form the Silurian strata, included in the upper part of which are two groups where graptolites abound. At the end of the Lower Silurian deposition, through the periods known as Upper Silurian and Devonian, there was an almost total cessation of the deposition of sediments. There seem to be two possible explanations for this fact: First, there may have been a depression of the sea-bottom which left this area so far from shore that no thick sediments were accumulated over it, and this was followed by an elevation in Lower Carboniferous times renewing sedimentation in perfectly conformable beds; the second explanation is that while upper Silurian and Devonian beds were being deposited elsewhere, the same period was occupied by a deposition in the Arkansas area characterized by Lower Silurian organisms. This continued until a decided change of conditions in Lower Carboniferous times renders necessary a change in the nomenclature of the beds in consequence of the change in the character of the fossils.

"True Coal-Measure strata covered the novaculite area also, for they are found in Texas in a latitude considerably south of 34° 30′, while the trend of the formation is nearly east and west through this part of Arkansas and through the Indian Territory. The south members of the coal strata of northern Arkansas have been worn completely away, and are now buried beneath the Cretaceous and Tertiary deposits which cover southern Arkansas.

"Following the formation of the Coal Measures, and probably synchronous with the Appalachian uplift, came the elevation of Arkansas above sea-level. The time following this post-Carboniferous elevation of Arkansas has been one of erosion, though we have evidence of some periods of accumulation as well as denudation. The three periods of accumulation were the Cretaceous, Tertiary, and Pleistocene, during which there were partial and perhaps complete submergences of the area" (pp. 206–207).

The final chapter of the volume deals with the fossils of the area. These, it is true, are few in number, but seem to be sufficient to justify the assertion of the Lower Silurian age of the deposit. Dr. R. R. Gurley contributes some remarks upon the graptolites found in shales both underlying and overlying the novaculites. His conclusion is that two horizons are represented, one of Calciferous, the other of Trenton age. Comparisons are drawn between the Arkansas beds and those of Point Levis in Canada, Calciferous in age, and those of Norman's Kill in New York, of Trenton age. A number of new species or varieties are described by Dr. Gurley. JOSEPH F. JAMES.

Washington, Aug. 11.

Outlines of Theoretical Chemistry. By LOTHAR MEYER. New York, Longmans, Green, & Co.

THE author of this volume is well known by the successive editions of his "Modern Theories of Chemistry" and by the share that he took in developing the periodic law of the elements. The larger work was translated some years ago by Professors Bedson and Williams; and the same translators have put this volume into good, readable English.

The author says (in view of the various works already published on theoretical chemistry): "I have not considered the requirements of students alone, but have been desirous of offering something to those friends of scientific investigation who have neither the intention nor the time to concern themselves with the details of chemical investigation, but wish to become acquainted with the general conclusions arrived at. With this object in view, I have abstained from too large a use of the numerical results of observations and measurements, and have avoided giving detailed descriptions of experimental methods. . . . The general — I may say the philosophical — review of the subject has been my chief aim, to which the details should be subordinated."

The author's purpose, as thus expressed, has been in good measure carried out. Chemists will prefer his "Modern Theories of Chemistry," if they would become really proficient in this aspect of the science; and to such this work may seem superfluous. But many, who are chiefly interested for practical reasons in chemical analysis or manufactures, may be glad to find so good an "Outline," compressed into 216 clearly-printed pages. The work is not made up of distinct chapters, but the sections seem to succeed each other in natural order, giving some prominence to the following topics: Atomic theory, the several methods of determining

molecular and atomic weights, the periodic law, valency, the constitution of chemical compounds, physical isomerism, density, fusion, refraction, solution, crystallization, diffusion, evaporation, constitution of gases, relations of heat to chemical change, dissociation, electrolysis, migration of ions, speed of chemical change, action of mass and avidity. The following sentences are from the concluding paragraph: "We have gradually receded from the idea of a static state of equilibrium of the atoms, brought about by their powers of affinity, and we now consider the atoms and the molecules, which are built up of atoms, as particles in an active state of movement. Their relations to each other are essentially determined by the magnitude and form of their movements. Chemical theories grow more and more kinetic."

Some Americans, at least, will dissent from the judgment of the author in still making the atomic ratio H : O equal to 1 : 15.96; but it may well be hoped that this well-balanced compend of leading theories, in its English dress, will widen the interest already shown in the philosophical aspects of this science. R. B. W.

Deafness and Discharge from the Ear. By SAMUEL SEXTON, M.D. Assisted by Alexander Duane, M.D. New York, J. H. Vail & Co. 89 p.

THE object of the writers of this small volume is to bring before the profession the merits of the operation of excision of the drum membrane and ossicles in cases of chronic deafness from catarrh. The theory of the operation is stated at length, and a number of cases in which it has proved successful are reported. It would have been more satisfactory if a complete tabulation of all cases had been offered, so that a more accurate estimate could have been formed as to results. From what is stated, however, the procedure is clearly one of much service in some instances.

Human Origins. By SAMUEL LAING. Illustrated. London, Chapman & Hall, 1892.

THIS is an exceedingly well-written and interesting summary of all the theories, facts, and mysterious questions connected with the origin of mankind on earth, by a somewhat remarkable man, whose previous works, "Problems of the Future" and "Modern Science and Modern Thought," met with a wide circulation in England. The author, Mr. Samuel Laing, the son of the translator of the Norse Sagas, comes of a good old Scottish family and was second wrangler of his year. Well-known in the House of Commons as "the member for the Orkneys," Mr. Laing twice served in Mr. Gladstone's administrations, as finance minister to India and financial secretary to the treasury, and is now the president of a prosperous English railroad. This veteran of finance and affairs has always found solace and delight in the study of abstruse scientific problems of the day. His various publications present the results of wide and discriminating reading and research, in a logical, concise, yet comprehensible style for the benefit of those who have not the time to look into such matters for themselves.

In the present volume Mr. Laing deals first with the abundant evidences of the existence of civilized man upon earth at least a thousand years before the date of the creation of the world as given by theological chronologists. A clear outline is presented of the condition of religion, art, science, and agriculture of "Old Time," as revealed by the earliest monumental records and inscriptions of ancient Egypt, Assyria, and Chaldea. These alone afford convincing proof of the great antiquity of civilized man and of the existence of a high grade of culture at the earliest dawn of the historical period, which was preceded by legendary ages of less duration and by the long-forgotten antecedent neolithic era and remoter epoch of palæolithic man.

The evidences of science are then considered as revealed in geological and palæontological records of the past. The effects of the glacial period, Croll's theory of its cause, and Quaternary, Tertiary, post-glacial, and inter-glacial and pre-glacial man are discussed in turn. The geological data from the Old and New Worlds, favorable and opposed to the antiquity of man, are stated with clear impartiality. The author seems well acquainted with the works of American scientists such as Abbott, Morton, Brinton, Wright, Whitney, and Shaler. He shares, however, in the prevalent confusion with regard to the Toltecs. His main argument is governed by the force of the logical postulate of continuous evolution. "No one now believes," he writes, "in a multiplicity of miracles to account for the existence of animal species. Is man alone an exception to this universal law, or is he, like the rest of creation, a product of what Darwinians call evolution, and enlightened theologians 'the original impress?'" He is therefore led to the conviction of the great antiquity of the human race. He would seek for human origins at least as far back as the Miocene period, and search in the earliest Eocene strata for the collateral ancestors both of the existing races of mankind and surviving species of anthropoid apes. "With this extension of time," he concludes, "the existence of man, instead of being an anomaly and a discord, falls in with the sublime harmony of the universe, of which it is the dominant note."

The volume is well illustrated from varied and modern sources. There are a few obvious misprints, such as Tyler for Tylor, trilateral for triliteral, Mortillot for Mortillet; which will doubtless be corrected in the forthcoming second edition. The first is already exhausted. AGNES CRANE.

Brighton, England, Aug. 1.

Essays upon Heredity and Kindred Biological Problems. By DR. AUGUST WEISMANN. Authorized translation by Messrs. Poulton, Schönland, and Shipley. New York, Macmillan & Co. 2 vols. 8°.

THOSE who have followed the active discussion of the remarkable investigations and stimulating hypotheses of the author of these volumes will not expect in this place a review of the works which have made his name famous even among those who have not been willing to accept all his conclusions. Such a review would be inadequately accommodated in a volume as large as either of those which are mentioned here. It would amount to a summary of existing biologic theory, which is being added to daily, almost hourly, and from which the teaching effect of time daily dissolves away some misconception or superfluity. In common with the great body of American naturalists we believe that the most talked-about strand in Weismann's woof of hypothesis — the assertion of the non-transmission of acquired characters — is not only an erroneous but an entirely unnecessary assumption, an assumption which, carried vigorously to its necessary conclusions, may well be termed the key-note of a genuine "gospel of despair." This assumption at present is upheld chiefly by a sort of circular argument which explains the "acquired character" to be one acquired by the body solely, exclusive of the reproductive plasma, while any character which is shown to be transmitted is put out of court as having been acquired by the "whole organism." But whatever be the fate of any of these special views, either of Weismann or his opponents, there can be no question as to the great importance of the questions involved, or of the scientific, honorable, and impartial spirit in which the great German naturalist has discussed them.

While many of the problems concerned are strictly scientific and to be adequately discussed by trained naturalists alone, some of the questions, and the conclusions which result from all, are of the utmost importance to every philosopher, theologian, and sociologist. It is therefore a matter for general congratulation that the essays in question have been put into English in a form which excludes all doubt as to the adequacy of the translation or the faithfulness with which his ideas have been presented.

The work appears with the well-known elegance of the Oxford Press, and should find a place in every working library.

Darwin, and after Darwin, an Exposition of the Darwinian Theory, and a Discussion of Post-Darwinian Questions. By GEORGE JOHN ROMANES. I. The Darwinian Theory. Chicago, Open Court Publishing Co. xvi., 460 p. 8°.

This treatise, the first of two contemplated volumes, has grown out of a series of lectures delivered before the University of Edinburgh, and is devoted to the general theory of organic evolution as Darwin left it. As these lectures were delivered to learners, and in their present form are intended for the general reader, the author states that he has been "everywhere careful to avoid assuming even the most elementary knowledge of natural science"

on the part of his readers. The natural consequence of this is that, for the intelligent American reader, who has learned his scientific alphabet long since, the book is liable to appear somewhat prosy and verbose. Having said this, our criticism is concluded, for it is certain that Mr. Romanes is fully conversant with his subject in all its branches, and a careful examination of the book has shown his treatment of the subject to be judicious, accurate, and fair. For all persons who desire a straightforward statement of what is implied by the term Darwinism when strictly construed, the book is to be recommended. Since public speakers, both in favor of and opposed to the doctrines of evolution and natural selection, are only too frequently given to singular misconceptions on this subject, it is fortunate that a work has at last appeared which presents a satisfactory summary of the theory for general reference, and we hope it may be widely circulated and carefully read by the numerous class for whom it is intended. Besides numerous diagrams of fairly good quality, the volume is embellished with Jeens's well-known portrait of Darwin, from the "Nature" series, which will be welcome to all admirers of the great philosopher.

The Indians of Canada; their manners and customs. By JOHN MCLEAN. Third Edition. London, Charles H. Kelly. 351 p.

MR. MCLEAN speaks from the experience of nine years spent among the Indians of the North-west, and is therefore excellent authority for what came within the scope of his studies. These embraced the languages, literature, native religions, folk-lore, and later Christian life of the wild tribes. He talks in an interesting manner about their heroes, traditions, mode of living, and customs, and describes the land in which the tribes he visited pass their lives. The impression the book gives, however, is that it has been written down to a popular style, and that the author could have prepared a much more valuable production, had he not felt it necessary to consult what he considered the taste of the average reader.

AMONG THE PUBLISHERS.

THERE is now in press a work specially written for the Jewish Publication Society by Israel Zangwill, of London. It is entitled "Children of the Ghetto, being pen-pictures of a peculiar people." It will be forwarded to members in the forthcoming autumn. Arrangements have also been made for the publication, this year, of the second volume of Graetz's "History of the Jews."

— Close upon the recent invasion of Manhattan Island by thousands of enthusiasts in the cause of the elevation of the human race, comes the dread news, says *The Publishers' Weekly*, of the stealthy entry of two enemies that has struck terror into the heart of every man who owns a book worth having. So wily has been their insinuation into our midst that it would be difficult to

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Taxidermist going out of business has quantity of finely-mounted specimens of North American birds, mammals and reptiles and skins of birds for sale, including a full local collection of bird skins, showing some great variations of species; also quantity of skulls with horns of deer and mountain sheep, and mounted heads of same. Will give good exchange for Hawk Eye camera with outfit. Apply quickly to J. R. Thurston, 265 Yonge St., Toronto, Canada.

To exchange; Experiment Station bulletins and reports for bulletins and reports not in my file. I will send list of what I have for exchange. P. H. ROLFS, Lake City, Florida.

For exchange.—A fine thirteen-keyed flute in leather covered case, for a photograph camera suitable for making lantern slides. Flute cost $27, and is nearly new. U. O. COX, Mankato, Minn.

Finished specimens of all colors of Vermont marble for fine fossils or crystals. Will be given only for valuable specimens because of the cost of polishing. GEO. W. PERRY, State Geologist, Rutland, Vt.

For exchange.—Three copies of "American State Papers Bearing on Sunday Legislation," 1891, $2.50, new and unused, for "The Sabbath," by Harmon Kingsbury, 1840; "The Sabbath," by A. A. Phelps, 1842; "History of the Institution of the Sabbath Day, Its Uses and Abuses," by W. L. Fisher, 1859; "Humorous Phases of the Law," by Irving Browne; or other works amounting to value of books exchanged, on the question of governmental legislation in reference to religion, personal liberty, etc. If preferred, I will sell "American State Papers," and buy other books on the subject. WILLIAM ADDISON BLAKELY, Chicago, Ill.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862-1885 (62-71 bound); Smithsonian Reports, 1854-1883; U. S. Coast Survey, 1854-1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

Wanted, in exchange for the following works, any standard works on Surgery and on Diseases of Children: Wilson's "American Ornithology," 3 vols.; Coues' "Birds of the Northwest" and "Birds of the Colorado Valley," 2 vols.; Minot's "Land and Game Birds of New England;" Samuels' "Our Northern and Eastern Birds;" all the Reports on the Birds of the Pacific R. R. Survey, bound in 2 vols., morocco; and a complete set of the Reports of the Arkansas Geological Survey. Please give editions and dates in corresponding. R. ELLSWORTH CALL, High School, Des Moines, Iowa.

To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—A position as zoological artist in connection with a scientific expedition, institution or individual investigations. Experienced in microscopic and all scientific work. References given if desired. Address J. HENRY BLAKE, 7 Prentiss Place, N. Cambridge, Mass.

YOUNG MEN destined for a medical career may receive instruction in branches introductory thereto, at the same time, if desired, pursuing the so-called elementary medical studies. Advanced students can have clinical instruction, use of modern text books, etc. Will take one or two students into my family and office. Such must furnish unexceptionable references. Quizzing by mail. Address Dr. J. H. M., in care of 417 Adams Avenue, Scranton, Pa.

CHEMIST AND ENGINEER, graduate German Polytechnic, Organic and Analytical, desires a position in laboratory or chemical works. Address 213½ E. 7th Street, New York, care Levy.

A MAN, 36 years old, of extensive experience, having the degrees of A.M. and Ph.D., desires a first-class opening as a teacher of Zoölogy and kindred studies in a college or university. Can furnish numerous testimonials or references as to success and skill in most modern laboratory methods. Address E. W. D., Md. Agr. College, College Park, Md.

A YOUNG MAN, with a thorough training in Analytical Chemistry (including analysis of minerals, food, water, etc.), and holding a diploma of the School of Practical Science, of Toronto, and good testimonials, desires a position as Analytical Chemist or as assistant to such. Address to WM. LAWSON, 16 Washington Ave., Toronto, Ontario.

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

WANTED.—A collection of postage stamps; one made previous to 1870 preferred. Also old and curious stamps on original letters, and old entire U. S. stamped envelopes. Will pay cash or give in exchange first-class fossils, including fine crinoids. WM. F. E. GURLEY, Danville, Ill.

WANTED.—To purchase laboratory outfit; balances, evaporating dishes, burettes, etc., wanted immediately for cash. C. E. SPEIRS, 23 Murray street, New York. P. O. Box 1741.

fix the exact date of their immigration. Their history really begins with the fine morning, last week, on which Mr. W. E. Benjamin of 751 Broadway, New York City, took from his shelf a worn leather-bound copy of Seneca, published in London in 1675, and found two healthy specimens of the genus *Aglossa pinguinalis* ensconced in a burrow through the bottom of the precious book.

— Harper & Brothers have in preparation an illustrated edition of Green's "Short History of the English People," a work which has probably been more widely read and enjoyed than any other of its kind. The illustrations have been selected with the purpose of carrying out the favorite wish of the author, to interpret and illustrate English history by pictures which should show how men and things appeared to lookers-on of their own day, and how contemporary observers aimed at representing them. Besides a large number of elegant wood engravings, the work will contain several colored plates, including reproductions from manuscripts, illuminated missals, etc., executed in the highest style of chromo-lithography. An exhaustive series of portraits of eminent persons will also be a prominent feature. The first volume may be expected shortly.

— Prof. Bernard Bosanquet of London, whose "History of Æsthetics" has recently been published by Macmillan & Co., has just completed a course of fifteen lectures at the School of Applied Ethics, Plymouth, Mass. His theme was an historical survey of Greek ethics, tracing to the present day the influence of Plato and Aristotle. In clearness, precision, and in power to interest and stir his hearers Mr. Bosanquet proved as effective a teacher as England has ever sent across the sea. His ability as a thinker has been familiar to American students through his work on logic, which takes high rank as an authority. A recently published volume in the Contemporary Science Series presents his "Essays and Reviews," showing him to be one of the most incisive and sympathetic writers of the time in the fields of ethical and philosophical inquiry. Mr. Bosanquet intends to visit Colorado and the Yellowstone region before returning to England next month.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19, 1891. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Botanical Laboratory, A.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School of Applied Science.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diphtheria, Tox-Albumin.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, The New Method of Protecting Buildings from.
Lissajou's Curves, Simple Apparatus for the Production of.
Maize Plant, Observations on the Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Some Recent, in the State of Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
Patent Office Building, The.
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Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
Psychological Laboratory in the University of Toronto.
Psychological Training, The Need of.
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Star Photography, Notes on.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
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Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
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Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

Aaron, Eugene M., Philadelphia, Pa.
Allen, Harrison, Philadelphia, Pa.
Baldwin, J. Mark, University of Toronto, Canada.
Barnes, Charles Reid, Madison, Wis.
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Beal, W. J., Agricultural College, Mich.
Beals, A. H., Milledgeville, Ga.
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Bostwich, Arthur E., Montclair, N.J.
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Conn, H. W., Middletown, Conn.
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Golden, Katherine E., Agricultural College, Lafayette, Ind.
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Hale, George S., Boston, Mass.
Hale, Horatio, Clinton, Ontario, Canada.
Hall, T. Proctor, Clark University, Worcester, Mass.
Halsted, Byron D., Rutgers College, New Brunswick, N.J.
Haworth, Erasmus, Oakaloosa, Iowa.
Hay, O. P., Irvington, Ind.
Haynes, Henry W., Boston Mass.
Hazen, H. A., Weather Bureau, Washington, D.C.
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Hicks, L. E., Lincoln, Neb.
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Hitchcock, Romyn, Washington, D.C.
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Hotchkiss, Jed., Staunton, Va.
Howe, Jas. Lewis, Louisville, Ky.
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James, Joseph F., Agricultural Dept., Washington, D.C.
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Kellerman, Mrs. W. A., Columbus, O.
Kellicott, D. S., State University, Columbus, O.
Kellogg, D. S., Plattsburgh, N. Y.
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Macloskie, G., Princeton, N.J.
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MacDonald, Arthur, Washington, D.C.
Marshall, D. T., Metuchen, N.J.
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Osborn, Henry F., Columbia College, New York City.
Osborn, Herbert, Agricultural College, Ames, Iowa.
Pammel, L. H., Agricultural Station, Ames, Iowa.
Pillsbury, J. H., Smith College, Northampton, Mass.
Poteat, W. L., Wake Forest, N. C.
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Schufeldt, R. W., Washington, D.C.
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Southwick, Edmund B., New York City.
Stevens, George T., New York City.
Stevenson, S. Y., Philadelphia, Pa.
Stone, G. H., Colorado Springs, Col.
Thomas, Cyrus, Washington, D. C.
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True, Frederick W., National Museum, Washington, D.C.
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Wake, C., Staniland, Chicago, Ill.
Ward, R. DeC., Harvard University, Cambridge, Mass.
Ward, Stanley M., Scranton, Pa.
Warder, Robert B., Howard University, Washington, D.C.
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West, Gerald M., Clark University, Worcester, Mass.
Whitman, C. O., Clark University, Worcester, Mass.
Williams, Edward H., Lehigh University, Bethlehem, Pa.

SCIENCE

NEW YORK, AUGUST 26, 1892.

IS THERE A SENSE OF DIRECTION?

BY J. N. HALL, M.D.

ALTHOUGH it seems to me beyond dispute that among the lower animals there is an instinct which teaches them to find their way to a given point regardless of darkness or of previous knowledge of the locality, I do not believe, as I formerly did, that man possesses a similar sense, if we may so term it. I believe that man's ability to find his way to a given point is dependent solely upon a habit of observation, almost unconscious, to be sure, in many cases, but necessary to the end in view. I shall not discuss the truth or falsity of the ingenious theory advanced a few years ago, that the pineal gland in the brain is the seat of such a sense in animals, and that they find their way by means of some perception by this portion of the brain of the direction of terrestrial electric currents. All reasonable men, I believe, are satisfied that animals have this ability to find their way. Thus, most of us are familiar with instances in which a cat, for example, has been taken in a box or satchel for ten, twenty, or even fifty miles from home, and has returned in such an incredibly short time that we may be certain she has travelled by the most direct route. Carrier pigeons transported in closed cars or in ships have no difficulty in determining their direction of flight, even when liberated out of sight of land. I have repeatedly, when in doubt as to my direction upon a prairie without roads or paths, given my pony his reins, as riders commonly do in such circumstances, and never yet knew one to come out at the wrong place. The cowboys of this region make it a rule to pick for night-herding well-broken horses that are known to be anxious to reach camp when given the reins. Such ponies, even if obliged to follow the herd away from camp for several miles, will find their way back in safety in spite of the darkness. This selection of certain horses for night-work does not in the least vitiate our conclusion. They are not chosen for their power of finding their way back, but for their known inclination to do so. Even these horses sometimes fail, as, for instance, in the face of a severe storm, for they drift with the wind at such times rather than face it. Thus I once started for home at midnight from a ranch four miles away. For the first mile my road led westward to a road that ran in a northerly direction to town. Upon this first portion, with nothing to guide him, for it was dark and the ground was covered with new fallen snow, the horse found his way easily. As I struck the road and turned his face fairly to the storm, he would hardly face it. As the thermometer fell to 27 below zero that night, and the wind was strong, it was not strange. In this case the pain in his eyes from the cold and the driving snow more than counterbalanced his desire to get to his stable, and so he preferred to drift with the storm rather than face it.

As I cannot conceive that a horse or pigeon should guide himself by the position of the sun or of the north star, even if we eliminate from the problem the well-known fact that darkness seems to make no difference in the exercise of this homing instinct, I think that we may take it for granted that animals and birds have this sense of direction, for examples similar to those given above might be given by the score. It might be supposed that this instinct had formerly existed in man, but had been lost during his progress toward his present state of civilization. Writers speak of the "unerring instinct" which guides the red man through the vast stretches of pathless forest in which he resides. But we are also told of the accuracy of observation of the individuals of this same race. The Indian is familiar with the path of the sun and the position of the heavenly bodies. He observes every thing within his horizon, the mountain ranges, prominent peaks, and passes; he notes every stream, its size, character, and general course; he sees all the prominent objects along his trail. If the sun is obscured, and he is temporarily lost, he accomplishes his orientation by observing the rougher bark on the north side of some varieties of forest trees; or he finds the wild morning-glory facing eastward at day-break, for the faithful Moslem is not more certain to look toward the rising sun. He no doubt observes, also, that the warping action of the sun's rays detaches the bark sooner from the south side of the standing dead timber than from the other sides. These and a hundred similar signs are to be read by the student of nature. Such a student, most emphatically, is the Indian. I have had occasion to note his wonderful powers of observation, and those more familiar with his habits than I am, inform me that only after years of experience, if at all, does the white man acquire his proficiency in this direction. We are told by travellers that it is much the same with other primitive races, the necessary qualities being intensified by inheritance through long generations of nomadic ancestors. But as we have advanced in civilization, and sign-posts have taken the place of the signs which the Indian reads, we have retrograded in these matters until the civilized man, despite his knowledge, is lost more easily than his barbaric ancestors, unless he takes especial precautions to note those things which they observed without effort.

It seems to me that our proposition, viz., that we keep our direction by observation, conscious or unconscious, of surrounding objects, will be established if we are able to prove these three things:—

First, that those lacking in the power of observation are most easily lost.

Second, that those in whom this faculty is well developed are rarely lost.

Third, that the latter are easily lost when they lose sight of all external objects, as in fog or darkness, or when their attention is concentrated upon something else to such an extent that they do not observe their surroundings.

I trust that my term "power of observation" is plain to all. In this connection I mean that faculty which enables one to note surrounding objects, and to bear in mind their relations to each other and to himself. I take it that the power which enables one to look at a landscape and say that it is familiar is the same as that which permits some of us to look at a word and determine whether or not it is spelled correctly; for I have long believed that notoriously poor spellers were such, not from poor memories necessarily, but

from lack of the faculty in question. Thus I have a friend with whom I have hunted on several vacation trips to the Rocky Mountains. He has an excellent education and a memory far better than the average, but is utterly unable to spell. He is the only man with whom I ever hunted who was afraid to hunt alone in a strange country for fear of getting lost. I have often been struck, in other matters, with his same deficiency in this direction. Thus, when we hunt together, he scarcely ever sees the game first, although when discovered at a distance, he is immeasurably my superior in determining what class of game it is, if so far off as to render this a matter of doubt.

This example I may count as the first point in establishing our first proposition. Next to observers poor by nature, we might place those who lack experience, as those who have always dwelt in cities. Of course the great majority of these acquire proficiency by practice. Short-sighted persons who do not correct their myopia by the use of glasses come under the same head, for, being unable to observe their surroundings, they are very prone to become lost. Fortunately this disease is comparatively rare in primitive races, natural salection, no doubt, contributing to render it so, for it is vastly more common in civilization.

Among the female inhabitants of towns and cities the faculty in question has had no opportunity for development for many generations, perhaps. They ordinarily have a very poor "sense of direction." I have yet to see a woman from civilized life who could be trusted to point out the way across a pathless region of any considerable extent.

Second, good observers do not readily lose their way. My experience in this regard has been largely with two classes of men, hunters and cowboys. Men of either of these classes, to be even moderately successful, must be the closest of observers. The appearance of a man or an animal anywhere within the circle of vision is ordinarily noted at once. The habit of seeing what lies before one, a thing not given to us all, is formed. With men who travel much alone, the exercise of this faculty fills the gap left by the lack of opportunity for conversation. It gives the mind a certain amount of exercise. The Mexican sheep-herder who is alone on his range will tell you, a week after, who has passed by, what kind of a horse he rode, whether a colt followed a certain wagon the trail of which he has seen, and other details that surprise one not accustomed to such matters. The cowboy who rides a hundred miles across country will tell you the brand of every stray steer he has seen. These men, realizing that they are dependent upon their own exertions for safety, unconsciously develop those faculties of service to them. Other men, placed in similar positions, develop in the same manner, as trappers, explorers, and scouts. Think, for instance, what chance there would be of a trapper's getting lost when he is able to place fifty traps in a new region and find them all without effort. Here his memory is, of course, of as much importance to him as his close attention to his surroundings.

Our third proposition is, that even those who are ordinarily entirely competent to find their way get lost easily in darkness, fog, or snowstorms, and especially if interested in something which thoroughly occupies the mind. This I believe to be utterly inconsistent with the theory of a proper "sense of direction." Examples are, no doubt, familiar to all, but I will quote one from my own experience, which to me is conclusive. I have for years been in the habit of hunting alone in my vacation trips, upon the plains as well as in the mountains, and have travelled much in unsettled districts, both night and day. Realizing the possibility of getting caught in a snowstorm, I have made it a rule to carry a pocket compass as well as a waterproof match-safe at all times. For eight years I never had occasion to use the compass to learn my position, and I almost believed I was infallible so far as the question of getting lost, in daylight at least, was concerned. But the undeceiving came, and it was that which led me to this study of the subject. One fine September day I started out from camp on a deer-hunt. We were in the part of Wyoming between the head-waters of Savory and Jack Creeks, about two miles from that portion of the Continental Divide which lies between them.

Within half a mile of camp I struck a deer trail and followed it. I pursued it for two or three miles, mostly through heavy timber, without seeing any signs of game, although momentarily expecting to do so. When I finally stopped for a moment, it had begun to rain, and the dense clouds shut in every hilltop. I could see nothing to indicate the position of the sun, and there was not a breath of wind. The rain increasing, I decided to start for home, and, turning farther to the right, followed, as I supposed, a tributary of Jack Creek down into the valley. What was my consternation to find that the creek into which it led flowed to the right instead of to the left as Jack Creek should do! Every thing was unfamiliar. I had crossed no ridge, to my knowledge, high enough for the Divide; I was dumbfounded. I knew, however, that I was upon the westerly side of Jack Creek, for I had crossed no stream of any description. In two hours I could not possibly have walked far enough up or down to cause me to miss it if I adopted an easterly course. The difficulty was in the fact that I had supposed that I had been following such a course in arriving at my present position. As the mist and rain now shut in every thing, I had nothing to do but to complete my humiliation by a forced resort to the compass, for I had to admit for the first time that I was lost. At first sight I was tempted to believe that the needle was wrong, as I am told all men in similar position are. I carried the compass to some distance from my rifle, fearing that the needle was deflected by the metallic barrel. The result was the same. Fearing that I had found a body of iron ore by accident, I tried various localities, but the needle still persisted in pointing, as it seemed to me, south. After a few moments' consideration I started over a ridge a little to the right of the way I had come, and due east by compass. I still felt that I was going west, and could not get over the idea. A tramp of half an hour brought me within sight of the valley I sought, and north seemed to come around where it should have been all the time. I had unconsciously crossed the Divide at its lowest point, far lower than the one at which I now crossed, evidently having made an entire turn when starting homeward instead of a half one as I had intended. I now made a bee-line for camp, but I carried home with me less faith in my "sense of direction" than I had upon starting out.

I might quote from the experience of others a dozen similar examples of losing one's way. Some seven or eight men have been more or less severely frozen in this very county, by losing their correct route. I believe that further examples are unnecessary. It is sufficient for me to say, in conclusion, that, whatever instincts man may have had in a former state, he has at present no means of finding his way at all resembling that possessed by birds and animals.

Sterling, Col.

CURRENT NOTES ON ANTHROPOLOGY.—XIII.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The Primitive Carib Tongue.

THE expedition led by Dr. Karl von den Steinen, which explored the head-waters of the Schingu River in Brazil, made some remarkable discoveries. Tribes were found who had never heard of a white man, and were utterly ignorant of his inventions. They were still wholly in the stone age, uncontaminated — the word is not misapplied — by any breath of civilization. In ethnography, the most interesting find was the identification of the Bacahiris with the Carib stem, and apparently its recognition as perhaps the nearest of any of the Carib tribes to the original stock.

Dr. von den Steinen has just issued his linguistic material obtained from this tribe in a neat octavo of 403 pages, "Die Bakairi-Sprache" (K. F. Koehler, Leipzig, 1892). It contains abundant sources for the study of the group, vocabularies, texts, narratives, grammatical observations, and, what is peculiarly valuable, a close study of the phonetic variations of the various Carib dialects as far as they have been ascertained. He shows that in all the associated idioms the same laws of verbal modification hold good, although each has developed under its own peculiar influences. The thoroughness which marks throughout this excellent study places it in the front rank of contributions to the growing science of American linguistics.

The Ethnic Distribution of Roofing Tiles.

As a floating leaf will indicate the current and eddies of a stream better than a floating log, so oftentimes a humble art will be a more accurate indication of the drift of civilization than the more ostentatious products of human ingenuity. This has been happily illustrated by Professor Edward S. Morse in a paper "On the Older Forms of Terra-Cotta Roofing Tiles," published in the Essex Institute Bulletin for March of this year.

He finds that the older roofing tiles of the world group themselves into three distinct types, the normal or Asiatic tile, the pan or Belgic tile, which is an outgrowth of the normal tile, and the flat or Germanic tile, which is an independent form. The geographic areas in which these various tiles are found and the history of their distribution are reliable indications of the conquest or peaceable advance of certain forms of civilization. Professor Morse's paper is abundantly illustrated, and an interesting map is added, showing the present distribution of the three types of tiles over Europe, northern Africa, and western Asia.

That his study may not remain one of archæology only, the author adds a number of practical hints on the use and value of terra-cotta tiles as roofing material, and suggests their wider introduction in the United States. They offer the best of all roofing material, durable, fire-proof, cheap, decorative, warm in winter, and cool in summer.

Celts and Kymrl.

Professor Topinard is not satisfied with the result of the discussion of the Celts in *Science*, March 11, 25, etc. He takes it up in *L'Anthropologie* for June, and draws a distinction between the Celts of the "men of letters," among whom he classes the editor of these "Notes," and the anthropologists, represented — by himself.

"For the former," he says, "the Celts are blonds, they constructed the megalithic monuments, and spoke a language now unknown. For the latter they are the brachycephalic people of western Europe, who appeared at the neolithic epoch, and lived during the age of bronze side by side with those who later bore the name of Gauls. . . . For Broca, the term Celt designated the brachycephalic group of western Europe, and the term Kymri the blond group, with long and narrow face, etc. We retain the meaning he gives to Celtic, but to meet certain objections substitute for the word Kymri that of Gall or Gaulois."

As the opinion of Broca to this effect was quoted with approval in the discussion (see *Science*, April 22), it is difficult to perceive the grounds on which the learned Parisian professor makes his objections. But it is desirable that his own views, which are always worthy attentive consideration, should be presented.

Architecture as an Ethnic Trait.

The significance of architecture as an ethnic trait has been fully recognized — too fully at times — in reference to the domestic architecture of the American Indians. The views of Mr. Lewis A. Morgan, who could see nowhere on the continent other than "long houses" and "communal dwellings," contained a genuine discovery which has been pushed at times beyond its reasonable limits.

Some excellent articles on this subject have appeared from time to time from the pen of Mr. Barr Ferree, in the *American Naturalist* and the *American Anthropologist*. He treats such subjects as "The Sociological Influences of Primitive Architecture," and the climatic influences which have given rise to this or that peculiarity or style. His essays are thoughtful and well reasoned.

In the first fascicule of the Bibliothéque Internationale de l'Alliance Scientifique, M. César Daly pursues this train of thought to the point of announcing — "given a social condition, it will have such a religion and such an architecture." In regard to "styles," he discriminates between that of the architect, which is transient, and that demanded by the tastes and requirements of the community, which depends on it alone and will last as long as these remain. "A style in architecture is therefore something national, social, and religious, and not royal, as that of Louis XIV., nor that of an artist, had he all the genius in the world."

Types of Beauty among American Indians.

In a note published in this series (*Science*, June 3), attention was directed to the power of beauty in developing the race toward a certain standard of physical perfection. Some interesting facts bearing directly on this topic are presented by Dr. R. W. Shufeldt in a recent pamphlet on "Indian Types of Beauty."

He begins with the suggestive remark that men of the lower type of development cannot perceive the beauty in the women of the higher type nearly so readily as the men of the higher type can recognize the comeliness in the women of the lower. This is as we might expect, the education in the elements of the beautiful being principally a result of development.

Dr. Shufeldt inserts a number of photographs of Indian beauties, an inspection of which will satisfy any one that the opinion which in their own tribe awards them the palm for good-looks is justified by all standards. The same fact is borne out by Mr. Power in his work on the Indians of California. He calls attention to the attractive appearance of the maidens of several tribes reputed among their own people as beauties.

While in all stages of civilization there are false and abnormal standards of the beautiful — notably so among ourselves — there is also a gradual and certain tendency toward

that ideal of physical form which the keen artistic sense of the ancient Greeks recognized as the perfection of corporeal symmetry. Wherever it is present in any degree, it is sure to be recognized. As Novalis says in one of his apothegms, "Beauty alone is visible."

SOME POINTS IN THE NOMENCLATURE-PRIORITY QUESTION.

BY LUCIEN M. UNDERWOOD.

THERE are some of our younger botanists who see no possible merit in the nomenclature-priority discussion. That this is the case is naturally due to the fact that neither their age nor training have been sufficient to enable them to obtain a general view of botany as a science in which the relations of plants to each other and to other living things form the crowning summit of achievement. When we say *relations*, we mean the word in its deepest and widest sense — morphologic, embryologic, physiologic, geographic, and chronologic.

To those whose work involves the weighing, sifting, and correlating of all the truth concerning some group of plants that has been found out by patient workers in times past and present, as well as that brought to light in their own comparative research, the necessity of some uniform, authoritative, and permanent system of nomenclature needs no argument. If some have acute inflammation of the morphologic nerve so that their attention is largely drawn away from the general wants of the system to the nursing of their peculiar member, they are worthy of our sympathy, but they must reduce their hypertropy before they can expect the botanical world to regard their judgment as normal outside their special sphere.

While we thoroughly believe in Goethe's assertion that "species are the creation of text-books while Nature knows only individuals," we have not yet advanced sufficiently far to be able to discontinue the present method of grouping individuals into species and recognizing them by certain fixed names. This is a matter of convenience, and it is a present logical necessity. We believe, therefore, that the matter of nomenclature ought to be settled at once and permanently, and this we believe to be the opinion of all who look at systematic botany, not as a mere "battle of synonyms," but in its true position, representing as it does the ultimatum toward which every fact in the science tends, and into which the whole science will be ultimately crystallized. So far is this desirable that if a system can be agreed upon, it must and ought to be by the yielding of personal opinions to the will of the best and maturest judgment of the botanical world.

One phase of the question has not yet been sufficiently dwelt upon, and that is the one which involves the element of personal justice. There are some who say that there is no ethical side to the question, that it is a mere matter of expediency. If *justice* pertains to ethics then there *is* an ethical element in the problem. It has always been maintained that a man has the right to the product of his brain. If he invents a new mechanical contrivance he is awarded a patent. If he writes a book he is given a copyright. If he discovers a new principle or process in the natural world his name is inseparably connected with that principle. Otherwise why do we speak of the Bell telephone, of Marsh's test for arsenic, or of Newton's law of gravitation? The same is true of discoveries in botanical science, for we inseparably connect certain names with the earliest recognition of protoplasm, the announcement of its identity with sarcode, the discovery of fertilization by antherozoids, the continuity of protoplasm, and every other important addition to a knowledge of the plant world. In the same way the recognition of a natural group of plants, an order, a genus, or even a species is now regarded as of sufficient importance to be credited to the one who makes the discovery, not by any means on the ground of expediency (though it is doubtless in the highest degree expedient), but because of an innate feeling of justice due him who thus publishes the result of his work.

It is true that favored students or organizations may, for a time, regard themselves as the only rightly-appointed medium of description of species, but the multiplication of botanical centres, the specialization of workers, and the growing urbanity and cordiality in extending to specialists the privileges of public and private collections will all tend to prevent the growth of monopolies in a field which is not likely to become narrow enough for any to jostle offensively.

As a worker in one group of plants we present some questions that have suggested themselves in our work, drawing illustrations largely from the genera and species with which we are most interested, seeking not so much to offer dogmatic principles as to call to mind the feature of personal justice.

1. Shall there be an initial date in nomenclature?

What justice on the one hand, or advantage on the other, is there in accepting those of Micheli's genera that were adopted by Linnæus, and rejecting others equally valid that were not? What virtue did the great compiler add to an adopted name that should render it either sacred or immortal? We have *Anthoceros* and *Sphaerocarpus*, *Blasia*, *Riccia*, and *Lunularia*, all established by Micheli in 1729, and all accepted to-day without question, forsooth, because they have received the stamp of the immortal Linnæus, who could scarcely distinguish a hepatic from other Bryophytes. And yet Micheli, the founder of generic distinctions among Cryptogams, who knew and studied plants, adopted other generic names at the same time; these the great Linnæus did not accept because he could not get down to the study of plants and learn to distinguish genera among hepatics and other Cryptogams. Are we of this age so blinded that we must fall down and worship this popularizer of botany and accept his dictum as against that of a man whose shrewdness enabled him thus early to discriminate genera among Cryptogams?

But we must have a starting-point, some say. Why not then commence genera with the men who first originated them? Let us not award merit where merit is not due. Let us not assume for Linnæus a virtue that he did not possess. Micheli, Ruppius, and Dillenius were the originators of genera among hepatics. Why not recognize their genera that represent natural groups? If others are the progenitors of genera in other groups of plants, there is no reason why their work should not also stand, provided their names were not already preoccupied.

2. Shall names long used be laid aside when claimed for other plants on grounds of strict priority? Shall we recognize the principle of outlaw in nomenclature?

For example, *Marsilea* (Micheli, 1729) is a hepatic which since Raddi's time (1818) has been known as *Pellia*. *Marsilea* Linn. has since its establishment been used for a genus of quadrifoliate Pteridophytes. Shall the latter stand in the face of evident priority? While a compromise of this kind,

sacrificing an individual for the general good, if it could be agreed upon by an authoritative body, would be in the interests of both science and peace, it could not be accomplished without personal injustice.

Another case more complicated is that of *Asterella*. This genus was established by Palisot de Beauvais in 1810. Raddi independently established *Reboullia* in 1818. After many years European hepaticologists, with Lindberg at the head, discovered that the two genera were identical; so *Reboullia* yielded to *Asterella*. Meanwhile Nees von Esenbeck had established the genus *Fimbriaria* (1820). Latterly Lindberg took a second thought and regarded Beauvais's three-line description as more nearly representing *Fimbriaria* Nees. So this generic name, known for over half a century, is laid on the shelf and *Asterella*, which we have been using for a totally different plant, is put in its place. On this basis *Reboullia* Raddi was restored.

3. Shall "the first name under a genus" hold against a previous specific name?

Riccia reticulata (Gmelin, 1796) was erected into *Corsinia* by Raddi, in 1818, under the name of *Corsinia marchantioides*. Shall this name hold, or shall we write *Corsinia reticulata* (Gmelin) Dumort. (1874)?

We believe the latter more justly covers the case, although on the ground that Raddi's name had been long in use this might be a proper time to sacrifice an individual for the public good!

4. Shall varietal names have priority over established specific names?

Madame Libert described *Lejeunea calcarea* in 1822. It proved to be the same as had been described by Hooker in 1816, as *Jungermannia hamatifolia β echinata*. Taylor in 1846 wrote *Lejeunea echinata* Tayl., perhaps more for displaying the caudal appendage than for principle, but he has not been generally followed until latterly, when there is a tendency to revert to his name. Since varieties, especially among Cryptogams, are too often established on mere sports, forms, or other slight variations, and species are the units of classification, we believe that description as a species ought to be the ultimatum in matters of priority. If Madame Libert had recognized the identity with Hooker's variety, and had named it *Lejeunea echinata* in the first place no one would have quarrelled with her, for it would have been advantageous to preserve Hooker's name. Since she named it *L. calcarea* we believe this name should stand.

5. Can inappropriate names be cancelled on that ground alone?

In 1867 Alphonso Wood established a new lileaceous genus from California under the name of *Brevoortia*. Out of compliment to the little daughter of the stage-driver who first showed him the plant, he called it *Brevoortia Ida Maia*. When Dr. Gray reviewed Wood's species a year later, we deem that he did a double injustice: (1) In hastily cancelling a genus which had not originated at Cambridge, and (2) in substituting a specific name on the ground that the one chosen was a compound. He thus obliterated all trace of Wood's discovery by writing *Brodiaea coccinea* Gray! The first injustice was partly atoned for by Dr. Watson who recognized Wood's genus as valid in his "Revision of the Liliaceae," but instead of writing Wood's name in accord with the principle of "the first name under a genus" he wrote *Brevoortia coccinea* Watson! It might be well to ask why *Ida-Maia* is any more objectionable than *Hart-Wrightii*, *Asagrayana*, *Donnell-Smithii*, or any other of the many compounds of our system.

To take another example, Berkeley established the genus *Cronisia*, closely related to *Corsinia*. Lindberg, not recognizing Dr. Gray's aphorism that "a neat anagram is not bad," cancelled *Cronisia* and substituted *Carringtonia* Lindberg.

We maintain that a name once established cannot be cancelled on the ground of offended personal taste even though it have the euphonious melody and the suspicious flavor of *Mariae-Wilsoni!*

6. How far has a later writer a right to correct names previously established?

We cite three instances:—

(1). In 1821 S. F. Gray established a large number of genera of British Hepaticae. To these he gave personal names *Kantius*, *Herbertus*, *Pallavicinius*, etc. These have been changed by Carrington to a feminine ending *Kantia*, *Herberta*, *Pallavicinia*, etc.

(2). Lindberg has adopted the plan of changing all personal names ending in *ianus, a, um* to *ii;* for instance, he writes *Jungermania* Helleri for J. Helleriana as originally written by Nees.

(3). *Tricholea* Dumort. was corrected by Nees to *Trichocolae* to bring it into harmony with its derivation. Dumortier originally wrote it *Thricolea*.

Except in manifest errors of orthography, names should be let alone.

7. What credit should be given for generic and specific names?

(*a*) Shall we write the name of the author of the specific name in case there has been a transfer to a new genus, and if so in parentheses or not? (*b*) Shall we write the double combination of the first describer of the species in parentheses followed by the name of the author of the generic combination? (*c*) Shall we write the name of the one who made the transfer?

While we shall hail with joy the time when the bare binary shall be all that is necessary to identify a plant, we believe the following to represent in a specific instance the order in which the demands of personal justice as well as scientific convenience are most fully met:—

(1). *Metzgeria pubescens* (Schrank) Raddi.
(2). *Metzgeria pubescens* (Schrank).
(3). *Metzgeria pubescens* Schrank.
(4). *Metzgeria pubescens* Raddi.

To write *M. pubescens* Schrank, makes that writer say what he never thought of saying. To say *M. pubescens* Raddi, in accordance with the system long familiar to us by the use of Gray's Manual, is to unjustly transfer the credit of the species where it never rightly belonged, and appears to us the most faulty system of all.

The above questions should be settled by a commission after the example, if not the manner, of the American Ornithologists' Union, if individuals of strong personality can lay aside their peculiar idiosyncracies and unite in a system that will both meet the demands of justice and at the same time serve the highest interests of the science.

To this commission could be referred minor questions like that of "once a synonym always a synonym;" how close may generic names agree in orthography[1]; what form of nomenclature is best for varieties, sub-species and "forms;" and the punctuation and capitalization of specific names. In nomenclature individuality ought to disappear and uniformity universally obtain.

DePauw University, Aug. 15.

[1] For example, should *Richardia* preclude *Riccardia*, or *Caesia*, *Cesia*?

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THE PROGRESS MADE IN TEACHING DEAF CHILDREN TO READ LIPS AND TALK, IN THE UNITED STATES AND CANADA.[1]

BY ALEXANDER GRAHAM BELL.

THE total number of teachers of the deaf employed in the United States in 1890 was 641, and in 1891, 686. This is an increase of 45. When we come to analyze the details we find that this is an increase exclusively of articulation teachers. This is shown by the following facts. In 1890, there were 213 articulation teachers employed, whereas, in 1891, there were 260,— an increase of 47 articulation teachers. The first statistics upon this subject were collected by the Annals in 1886. In that year we find articulation teachers constituted 32.8 per cent of the hearing teachers in our schools for the deaf. In 1887 they constituted 40.5 per cent; in 1888, 44 per cent; in 1889, 45.7 per cent; in 1890, 45.2 per cent; in 1891, the latest returns, 50 per cent. Indeed, they constituted one more than 50 per cent. There were 260 articulation teachers to 259 hearing teachers who were not engaged in articulation work.

In regard to the proportion of deaf pupils taught speech, the increase during the past year has been very marked. In 1890, there were 3,682 deaf children in the United States taught speech; in 1891, 4,245, an increase of 563. In 1890, 41.3 per cent of our pupils were taught speech; in 1891, 46 per cent. I am sure that this increase is due very greatly to the stimulus of the first summer meeting of the American Association to Promote the Teaching of Speech to the Deaf.

Of course, the statistics in the Annals include the whole of our pupils, old as well as young, and it has occurred to me, therefore, that they may not give us a true indication of the extent to which the California resolution is being carried out in the country at large; and that a better indication would be obtained by statistics concerning younger pupils alone. I therefore sent out a circular letter of inquiry to the superintendents and principals of American schools for the deaf, requesting: —

1. The total number of new pupils admitted during the school year just closed.
2. The number of new pupils taught speech; and
3. The number of these taught by speech.

Replies have been received from schools containing 7,987 pupils, or 80 per cent of the whole number under instruction in the United States and Canada.

The following table shows the results of the inquiry: —

Speech-Teaching in American Schools for the Deaf, 1891.

Schools for the Deaf.		Number of Pupils in Year 1891 [Annals of January, 1891].			New Pupils Admitted in School Year Ending June, 1892 [Replies to Circular of A. G. Bell].				
		Total pupils.	Total taught speech.	Percentage taught speech.	Total new pupils.	Total taught speech.	Total taught by speech.	Percentage. Taught speech.	Percentage. Taught by speech.
United States.	A...	5,614	2,960	53	836	580	363	69	43
	B...	1,619	759	47	266	189		71	
	C...	1,999	536	27					
Total.......		9,232	4,255	46	1,102	769		70	
Canada.	A..	445	92	21	59	20	5	35	8
	B..	309	132	43	63	41		65	
	C..	39	5	13					
Total......		793	229	29	122	61		50	

A. Complete returns were received from these schools.

B. The returns received from these schools did not state definitely the number of new pupils taught by speech. The Canadian schools marked *B* refer to the two Roman Catholic schools in Montreal. They return 126 pupils, or 41 per cent of the whole, as taught by speech; but do not state how many of the new pupils were so taught.

C. These schools did not reply to the circular letter of inquiry.

It is encouraging to note that while 46 per cent of the whole number in our schools last year were taught articulation, 70 per cent of the younger pupils were afforded an opportunity of learning to speak. The statistics published in the Annals are somewhat defective because, while they give us the total number of pupils taught speech, they do not give us the number taught by speech; so that we have no statistics by which we can measure the progress of the oral method of teaching in America.

Professor Joseph C. Gordon of the National Deaf-Mute College, in some editorial remarks prefacing a volume entitled "The Education of the Deaf," about to be issued by the Volta Bureau, says: "The returns of pupils taught by speech are incomplete. The number reported for 1891 is 963, or 10.4 per cent of the school population." The above table indicates that the percentage, in the case of the younger pupils, must be very much larger. Out of 836 new pupils admitted during the past school year, 336, or 43 per cent, were taught by speech.

This percentage, however, is probably excessive, because the table shows that those schools which have done the most

[1] Address delivered at the conference of the superintendents and principals of the schools for the deaf of North America, held at Colorado Springs, Aug. 8-11.

work in articulation teaching have been the most ready to respond to inquiries relating to the subject. We cannot, therefore, assume that the percentage holds for the schools that have not replied to my circular letter.

Still, even if we assume that these 363 deaf children were all who were taught by the oral method, the percentage must be very much higher than that given by Professor Gordon. This will be obvious from the following considerations: —

The schools containing these cases had a total attendance of 5,614 pupils, of whom 836, or 15 per cent, were new pupils admitted during the past school year.

If this proportion held good for the whole country, then there must have been a total of 1,385 new pupils — or 15 per cent of 9,232 — admitted during the year just closed.

Now 363 of these, at least,— or 26 per cent,— we know were taught by speech. Hence, for the younger pupils, the true proportion taught by speech lies somewhere between 26 and 43 per cent of the whole. The lowest estimate very much exceeds the figures of Professor Gordon.

We have no means of ascertaining whether the proportion of our pupils taught by speech is increasing or diminishing; and I think it would be well to direct the attention of the editor of the Annals to the importance of collecting and publishing statistics upon this subject.

I have glanced over the most recent reports of American schools for the deaf, and there are a few points contained in them to which I shall direct your attention.

In the twelfth biennial report of the American Asylum at Hartford, the principal, Dr. Job Williams, gives his views upon what constitutes success in articulation work. He says: —

"We hold that direct and earnest effort should be made, by expert teachers of those branches, to teach speech and speech-reading to every pupil, and in no case should that effort be abandoned, until those teachers are convinced that the pupil will never acquire enough of speech to be of any practical use. In some very unpromising cases the possibility of acquiring speech is not given up for two or three years. Here let me say that the criterion of success in speech should not be perfect naturalness of tone and inflection. It would be unreasonable to expect that, where the sense of hearing is wanting. Intelligibility is the prime requisite of good speech. Tone and inflection are secondary considerations. Any pupil who has mastered speech and lip-reading so far as to be able to carry on conversation in regard to the ordinary affairs of life in speech so plain as to be readily understood by the members of his own family, even though others fail to understand him, should be counted as a successful articulator and lip-reader. It is worth while to continue the instruction in these branches in many cases where the degree of success falls considerably short of the ability to carry on an extended conversation, provided that what of speech is acquired is easily understood. We must recognize the fact that intelligible speech is the readiest and most acceptable means of communication with people in general, but it must be intelligible. It is worth while for a child to gain even a limited amount of speech and lip-reading (the latter is as important as the former) in all cases where it can be done without serious sacrifice in mental development and acquisition of language."

We all must agree with Mr. Williams in these remarks. We should, of course, aim to have our pupils speak so clearly and distinctly that anyone can understand them; but I am sure Mr. Williams is right in saying that a much lower degree of proficiency might constitute a pupil a successful articulator and speech-reader. Mr. Williams rightly claims that oral instruction is successful if the speech of pupils is intelligible to their friends in their own homes, and among their own people, even though others have difficulty in understanding what they say. It is a very difficult thing for a teacher, and especially for an articulation teacher, to realize this. I have been myself a teacher of articulation, and I know how they feel. Their ears are sensitive to mispronunciations, as mine were. It is difficult for them to realize that voices, which to them may be disagreeable in tone, may be very sweet and pleasant to those at home. It is difficult for them to realize that imperfect speech may be better than none at all; and that speech so defective as to be unintelligible to strangers, may be of the greatest value to the pupils in their own homes, and among their own people, as a means of communication. This fact has been specially impressed upon my attention by the report of the Mississippi Institution, which, in many respects, is a very remarkable document. That institution has had a class of twelve pupils taught altogether by speech and speech-reading. While all of them have made great progress in speech-reading, some have gained but little power of speech.

Mr. Dobyns, the principal, says: —

"While I have been more than satisfied that the institution was justifiable in the small outlay in this department of instruction, yet, for fear my zeal to keep pace with the times may have gotten the better of my judgment, I submitted the following questions to the parents of the pupils in this class, knowing that they desired the very best thing for their children."

I will not take up your time by reading the questions and replies, but will merely say that the answers demonstrate, that speech, which may be thought very little of by the sensitive ear of the teacher, is considered a blessing at home. None of these parents desire their children to be removed from the oral department of the school; but, on the contrary, they all earnestly request that their children be continued in this department. Where there is any difficulty in deciding upon the value and success of the articulation taught to our pupils, with whom should the decision rest? Surely with those who are nearest and dearest to our pupils,— with those who have their interest most at heart. Mr. Dobyns, I am sure, is right in referring the question to the parents and friends at home.

In this report, Mr. Dobyns incidentally remarks that now, whenever a new pupil enters the institution, the request comes from the parents: "Please see if you can't teach my child to speak." He has, therefore, asked from the Mississippi Legislature an increase of appropriation to enable him to employ another articulation teacher; and I am sure we all hope he may get it.

There is another point in the report of the Mississippi Institution to which I would direct your attention. Mr. Dobyns has collected and published statistics concerning the earnings of former pupils, and he goes to his State Legislature with the proof that the graduates of his school, so far from being dependent upon the public for support, are actually wealth producers, earning annually a larger amount than the State appropriates for the support of the school. He proves that it is not a matter of charity to educate the deaf; and demonstrates that the money appropriated for this purpose is in the nature of an investment, yielding profitable returns to the State.

I would urge all schools for the deaf to carry out this plan of Mr. Dobyns, and collect statistics concerning the earnings

of former pupils. I would suggest that these statistics should be so tabulated as to distinguish the earnings of the pupils who could articulate and read speech from the mouth, from those who could not. I have no doubt that pupils who speak, have an advantage in life over those who do not; and that statistics will demonstrate that their average earnings exceed the average earnings of those who are unable to articulate. If this should turn out to be the case, what an argument it would be to present to legislatures in favor of appropriations for articulation teaching?

I venture to predict, we shall find that our former pupils who speak, even though they may be unable to read speech, earn more per annum than those who are forced to resort exclusively to manual means of communication; and those of them who can read speech, as well as speak, are still better off in life.

Mr. Davidson of the Pennsylvania Institution has suggested another valuable line of inquiry. From a comparison of numerous letters in his possession, he makes the assertion that orally-taught pupils improve in their knowledge and use of language after leaving school. I would suggest the importance of preserving uncorrected letters of your pupils during the whole period of their school life, and of keeping up correspondence with them after they leave school. A comparison of letters written by the same pupil at different periods of time would be invaluable as a means of determining his progress; and the correspondence in adult life might be utilized, for the purpose of collecting statistics concerning the earnings and general success in life of our pupils.

REMARKS ON NORTH AMERICAN LICHENOLOGY.—PRELIMINARY.

BY W. W. CALKINS.

IN introducing the above title for my subject, I owe to myself and to the promoters and patrons of a journal embracing the scope, influence, and popularity of *Science* an explanation of my purpose in bringing into public notice that department of botany which it appears to me as an humble worker in this field has heretofore received too little attention from botanists and institutions of learning in North America. My object is, then, to contribute in some measure towards the upbuilding of a more general interest among students in what seems to have been considered an uninteresting and obscure field of research.

In other departments there are workers by the hundreds. In American lichenology only one name and one life stands out pre-eminent as the founder, promoter, and able exponent of the science, Edward Tuckerman. He has gone to his rest, but his works remain. As a systematist, he brought order out of chaos. He formulated and developed a classification more nearly approaching Nature in her arrangements and divisions of the Lichens than any previous authors,—unless it be Elias Fries and Dr. Nylander,—both illustrious names.

This system, thus established by Tuckerman, is the basis of the science in this country, and his published writings the sole text-book and guide of the American student. Tuckerman's style of writing is certainly unique,—*sui generis*,—but when once comprehended, impressive and convincing, as well as clear. I confess to long vigils before I could understand him. Having had the benefit of collecting and comparing the greater part of the species described by him in their native habitats, my admiration for his profound knowledge, apprehension, and far-seeing into the secrets of nature, as evinced by what he calls "habit," increases with each review of his works.

This was made plainer to me from recent investigations in Tennessee, Alabama, and Georgia, by the fortunate finding of several rare saxicolous species which Tuckerman described, and which had not been seen since Judge T. M. Peters discovered and sent them to him. There were doubts in my mind which were now dissipated by an actual review *in situ* day after day, as I wandered over the calcareous rocks of the mountain region where found. I will now only specify one species, *Pannaria stenophylla*, which grows intermixed and cunningly hidden with another but more common form, *Pannaria Petersii*. The thallus and reddish-brown fruit are scarcely distinguishable at first. I am indebted to the keen discrimination of my friend S. Higginson for the complete settlement of this rare species.

Since Tuckerman's death no one has appeared to fill his place; the nearest approach being Henry Willey, who, however, has retired from active work, but not without leaving two publications of great value. In a recent letter to me from Dr. Nylander, he laments these losses to American science. But what has been can be. We must wait for some one of pre-eminent ability and adaptation to grow into the vacancy. Meantime, I doubt if anyone in the United States is making a special study of Lichens. Two or three have considerable knowledge of them, however. This is to be regretted. An inviting field, vast and rich, is open and offers great rewards. Who would exchange a fame like Tuckerman's for any amount of worldly wealth! I apprehend that he himself did not realize the extent or value of his own labors to which his entire life was devoted; neither the gratitude of his followers and successors, who without the works he left would be without a guide, and like an army without a general. I am sure that my co-laborers will agree with me in this. We may then be considered as entering upon a new era in the prospects and progress of the study in this country, which is coincident with the tremendous strides shown in phænogamic botany and in the increasing number of students in cryptogamia — as the fungi. Having myself for many years worked in those fields and witnessed the growth and increasing number of students, I have watched for corresponding interest as to Lichens. From the evidence received by me, the future is promising.

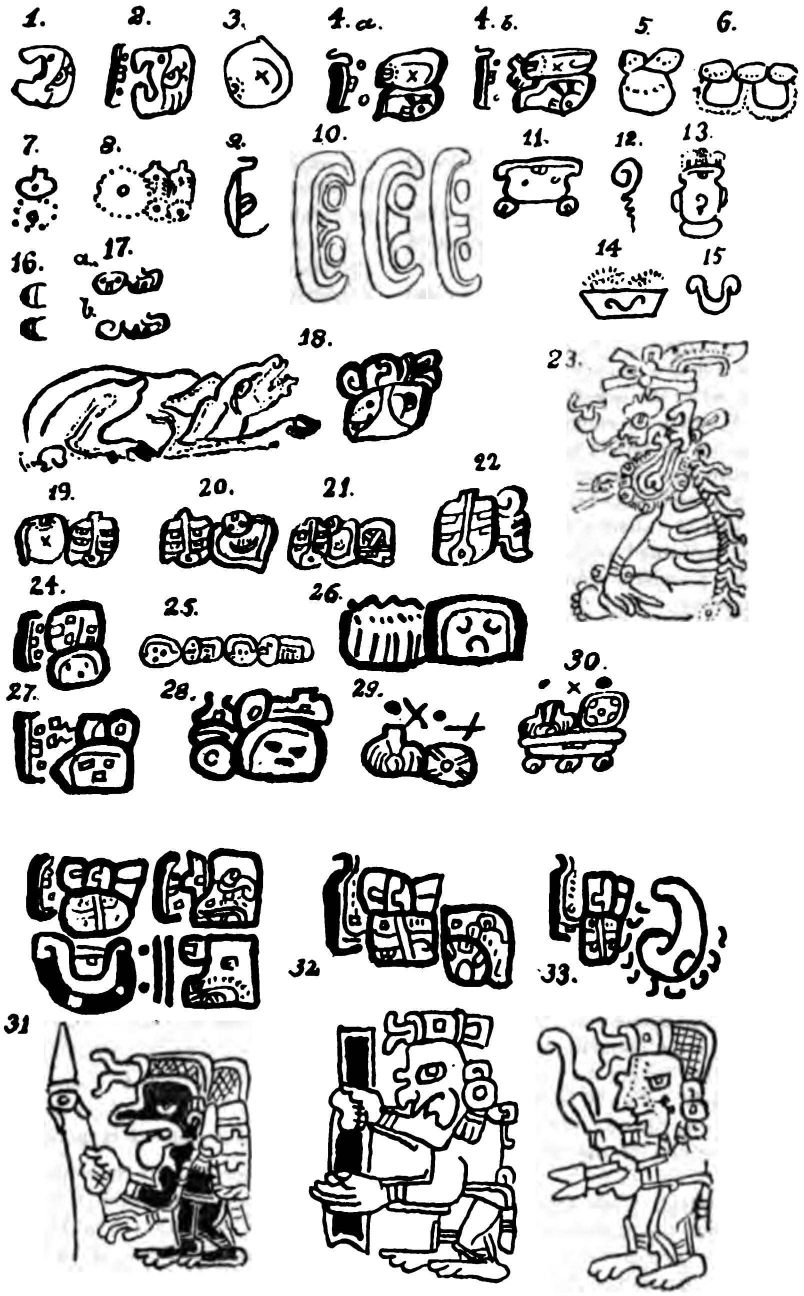
While specialists in Europe have explored every corner, and the great Nylander has given a lifetime of labor to this subject, the species of only detached portions of America have been investigated. The extreme south of our coasts and the far west are almost a *terra incognita*. The subtropical portions are prolific in new species and rare forms. It was my fortune to find and submit a large number of these to Willey and Nylander, yet I merely skimmed over the surface. The southern Appalachian Mountain region is almost as interesting in its rock forms, which are the most difficult perhaps to study (*vide* Nylander on my new Tennessee species). Their interest is, however, exceedingly great. While it is true that hundreds of new forms remain to be discovered, and are a great incentive to the explorer, yet it is clear that the resolution of those now known will afford active and valuable work to whoever undertakes it. It being admitted that the study of Lichens is difficult, still with such aids as I have mentioned, and ready access to the increasing herbariums and literature of the subject, the obstacles and objections disappear rapidly,—it being supposed that one pursues the subject *con amore*.

147 California Ave., Chicago, Ill.

LETTERS TO THE EDITOR.

Does There Really Exist a Phonetic Key to the Maya Hieroglyphic Writing?

IN No. 494 of this journal Professor Cyrus Thomas attempts to give a key for the interpretation of the Maya hieroglyphic writing, taking as a guide and starting-point Bishop Landa's well-known alphabet. It is not for the first time that in this way an interpretation of the Maya Codes has been attempted; but as yet most scientists were of the opinion that these attempts failed to give a satisfactory result.



The hieroglyphs given as letter symbols by Bishop Landa without doubt possessed a certain phonetic value. For instance, Landa's first *a* (Fig. 1) is the head of the turtle, *aac*, represented by a quite similar hieroglyph (Fig. 2) in Codex Cortez, 17 a. Landa's *cu* (Fig. 3) is the same hieroglyph as that of the day *cauac*, and conveys the ideas of the cloud and of heavy things, as, for instance, a stone. It is an essential element of the hieroglyph (Fig. 4) which expresses the idea of carrying a load on the back, *cuch*. Landa's *ku* (Fig. 5) is the hieroglyph of the bird named "quetzal" by the Aztecs and *kukul* by the Mayas. The sign of this bird (Fig. 6) is seen in Dresden 16 c and Troano 17* b. Landa's *o* (Fig. 7) seems to exhibit the characteristic elements of the hieroglyph of the great red macaw, *mo*, as seen in Dresden 16 c (Fig. 8). Landa's first *u* (Fig. 9) is a well-known hieroglyphic element, exhibiting on the Copan steles the forms shown in Fig. 10, and undoubtedly conveying the idea of a face, *uich*, perhaps of a bird. The same hieroglyphic element frequently occurs on the neck of the food dishes and drinking cups (Fig. 11), probably on account of the face with which the Indians used to ornament that part. Landa's second *u* (Fig. 12) and hieroglyphic element, which is also seen in the sign of the day *cib*, occurs on the jars filled with spirit-liquor (Fig. 13). It appears to be a modification of a similar design on the Aztec drinking cups (Fig. 14). The latter refers to the *ome toch* symbol, that is, the semi-lunar curved and hook-nosed ornament of the *Totochtin*, the wine gods (Fig. 15). This element therefore, seems to convey the idea of drinking, *uuk*. At last, the sign of aspiration given by Professor Thomas (Fig. 16) is certainly not a "Spanish fabrication," but it is Brasseur de Bourbourg's fabrication, since it is not seen in Landa's text. It has been added to the text by Brasseur de Bourbourg's wholly arbitrary decision. See the photographic reproduction of the

page in question in the publication of Landa's text procured by D. Juan de Dios de la Rada y Delgado. In the hieroglyphic writing the element Fig. 16 occurs as a substitute for the element Fig. 17. The latter, probably, is intended to render the head and the wing of a bird.

It is quite probable that in Landa's time the Mayas used to write in the manner indicated by Landa; we observe the same in the Mexican area. At a certain time after the conquest the Indian writers were inclined to restrict the phonetic value of their old hieroglyphs, in order to write with them in the same manner as the Spaniards did with their respective hieroglyphs. Compare the so-called Codex Vergara of the Aubin-Goupil collection. But this was not so in ancient times. Certainly there existed in the Maya writing compound hieroglyphs giving the name of a deity, a person, or a locality, whose elements united on the phonetic principle. But as yet it is not proved that they wrote texts. And, without doubt, great part of the Maya hieroglyphs were conventional symbols, built up on the ideographic principle.

In order to illustrate the combination of his letter symbols, Professor Thomas gives a few interpretations of groups of compound characters.

This first group (see above, p. 45, Fig. 2) contains in the second hieroglyph (reproduced in my Fig. 24) the elements given by Landa (Fig. 25) as expressing the sounds *l*, *e*, i.e., *le*, the lasso, the sling; and, indeed, in the figure below a turkey is seen hanging in the sling. I do not venture to settle the question by giving an explanation of this hieroglyph. I will only remark that the second element of this sign, that given by Landa as expressing the sound *e*, occurs in various compound hieroglyphs (see Figs. 26-28). In all these cases the action represented refers to handling a rope or to working up thread. Fig. 26 (taken from Codex Troano 31 * b) refers to handling the rope trimmed with thorns that the penitent used to draw through the pierced tongue (see the Relief of Lorillard City, published by Charnay). Figs. 27, 28 (taken from Codex Troano, 11 *) refer to weaving and embroidery. It would be a curious coincidence that the words expressing these different actions should all contain an *e*, while considering the idea expressed, the coincidence is a given one.

Considering the third hieroglyph of this group — which is indeed that of the turkey, *cutz* (see Fig. 19), one is in like manner induced at the first glance to think of a phonetic constitution. For the first element is that of the day *cauac*, given by Landa (Fig. 3) as expressing the sound *cu*. And the second element — wanting in Landa's as well as in Professor Thomas's list of letter glyphs — would seem to record the sound *tz*, because it renders the conventional design of a headless carcass or skeleton, *tzictzac*, seen from behind, or in front, with its ribs and the anal opening. Compare the Fig. 23, the design of a skeleton (the death-god) seen "in profile." Nevertheless, it would be a hasty conclusion to proclaim as established and beyond doubt the phonetic constitution of this hieroglyph. For the same element of the skeleton occurs in other hieroglyphs, expressing things the names of which do not contain a trace of the sound *tz*. Fig. 20 is the hieroglyph of the dog, *pek*; Fig. 21, that of the dog of the heaven that carries the lightning; Fig. 22 is the hieroglyph of the month *kan-kin*, "the yellow (or ripe) sun."

But it is principally the first hieroglyph of the group in question that rouses the gravest doubts about the rightness of Professor Thomas's interpretation. The whole group forms part of a series of representations, filling the upmost division of Plates 24 *-20 * of the Codex Troano, and recording, undoubtedly, the capturing of animals. The series begins with the prey-gods of the five regions. These are followed by various representations showing the hunting god — with a captured turkey under the arm, or holding a bag, or armed with spears and throwing-stick (Fig. 33); the black god (Fig. 31 = *Ekchuah ?*), and different captured animals, an armadillo (?) in the trap loaded by heavy stones, a turkey seized by the snare, a deer seized by the snare, a deer impaled on the pointed flint erected in the bottom of the pit, a pizote seized by the snare, and a turkey entangled in the hunter's net. Each figure is accompanied by a group of four hieroglyphs (as a rule). The first hieroglyph is the same in all the groups (see Fig. 2, page 45, and my Figs. 31-33), and undoubtedly refers to the action of capturing. This action is clearly indicated by the form of the hieroglyph that exhibits the head of the victim with the bloody, empty eye-hole, the conventional symbol of sacrifice. This head is held within a sling, the knot of which is seen on the summit. Compare the more accurate design of this hieroglyph in Fig. 18, taken from the Dresden Codex 60 a. In this hieroglyph all is figurative and ideographic; no trace of phonetic constitution can be observed.

The fourth hieroglyph of the group (Fig. 29) is interpreted by Professor Thomas as the second day of the month *yax-kin*. But this is obviously erroneous. There does not exist a numeral designation with crosses between the dots. Fig. 29 seems a variant of the hieroglyph seen in Fig. 30 placed on a bowl. In the latter hieroglyph, the second element signifies *kan*, the yellow color. It is replaced in Fig. 29 by the element *kin*, the sun. The hieroglyph Fig. 30 — which in a former communication was interpreted by Professor Thomas as signifying "moisture" — occurs on different pages of the Dresden Codex among the figured representations of offerings (turkey, lizard, fish, deer). Undoubtedly it means an eatable thing, perhaps honey.

I do not enter into a discussion of the second sample given by Professor Thomas (Fig. 3, p. 45), because I find nothing in it that might impel me to accept the translation given by him.

As to Professor Thomas's third sample (Fig. 4, p. 45), I agree with him that the boards covered with the hieroglyphic design of the day *cauac* may be intended for "wood" or "wooden." The same board is seen in Troano 12 * c, but fitted with a twisted handle on its surface. Here the first and fourth hieroglyph of the group are also seen; the second one is wanting. Variants of the first hieroglyph occur in Troano 35 a, 35 b, 34 b, and Cortes 21 a, where the figure below shows the god beating a drum. Professor Thomas's explanation, *mul-cin*, "collect together," is merely hypothetical. The same applies to the fourth hieroglyph. It is the same as that given by Landa as expressing the sound *x*. It is materially identical with that of a well-known deity exhibiting in his face the same characteristic design as the face that forms the essential part of this hieroglyph. In Troano 11 * this hieroglyph accompanies the elements which seem to express the action of weaving. And on the two contiguous plates, Codex Troano 35 * and Cortes 22, it is connected with red numerals and forms a row alternating with rows of various offerings. It is scarcely probable that in all these cases the reading *xaan* should correspond to the matter expressed.

The problem of the Maya writing is a difficult one. I cannot convince myself that the list given by Professor Thomas as letter glyphs acts as a key to its interpretation. For the samples of translation he adduces are not forcible, and include misunderstandings. In my opinion, in the present state of things it would be far more appropriate to point out the real meaning, as to the matter expressed, of each hieroglyph. The determination of their phonetic value will then follow, and consequently will then be done with much more accuracy. DR. SELER.

Steglitz, Germany, Aug. 7.

The Fundamental Hypotheses of Abstract Dynamics.

IN Professor MacGregor's interesting paper "On the Fundamental Hypotheses of Abstract Dynamics," the suggestion is made that a fourth law of motion should be added to the three laws of Newton. The proposed law is, in effect, that the magnitude of the stress between any two particles depends solely upon the distance between those particles. Combined with Newton's third law, the new law is thus stated : —

"Natural forces may be considered to be attractions or repulsions whose magnitudes vary solely with the distances of the particles between which they act."

The reason assigned for introducing this law is that "the fundamental hypotheses of dynamics should either include" the law of the conservation of energy "or give it by deduction." This reason seems hardly sufficient. In order that the law of the conservation of energy may be true it is not necessary that the stress between two particles shall depend solely upon the distance between them. It is necessary only that "the work done during any change of configuration of a system of particles acted upon

tural forces" shall depend "only upon the changes in the ons of the particles, and not upon the paths by which, or elocities with which, they have moved from the old positions e new."

w let P denote the magnitude of the stress between any articles of a system and r the distance between those parti- then Pdr is the work done by this stress during an infinitesi- lisplacement of the system. The work done by the stresses een all particles of the system during a finite displacement $\int Pdr$, in which the summation is extended to all pairs of les and the integration covers the whole displacement of the m. Now if ΣPdr is the differential of a function of the tities r, the value of the integral will depend only upon itial and final relative positions of the particles. But the nption that each P is a function of the corresponding r only ccordance with the proposed fourth law) is only one of many ble assumptions, any one of which would make ΣPdr the ential of a function of the quantities r. The mathematical ment of the condition that ΣPdr shall be a perfect differential en in treatises on "Differential Equations."

thus appears that the principle of the conservation of energy not require the truth of the proposed fourth law. The law be true nevertheless; but it may well be questioned whether uth is established with any such degree of probability as d entitle it to rank with the laws of Newton as a fundamental thesis of dynamics. L. M. HOSKINS.

dison, Wis., Aug. 16.

The Black-Knot.

r p. 10, Vol. XX., of *Science* appears an instructive chapter on ck-knot," a fungous disease of the plum and cherry, of h trouble to cultivators. A point of additional scientific in- t is that this fungus illustrates a principle long since pre- d by the writer of this, that nature does not place species e it is for the best interests of the individuals of the species, generally has some ulterior purpose not always apparent to ho are eager to uncover her intentions. For instance, there numberless trees and shrubs that struggle along in swamps, are rarely found elsewhere, and these have come to be known 'swamp-lovers," but close observation has shown that the tree or shrub will thrive immeasurably better when removed y ground.

the writer's grounds is a specimen of *Clethra ulnifolia*, fif- feet high and as much wide on an especially dry spot, and ing with a luxuriance rarely seen in the swampy spots where re has located the plants. Some reason has been found for ppearance of these plants in swamps and not in dry ground rally in the fact that the seeds will not sprout in dry, but in wet ones. It looks like a *flat* of nature. "Though you ld like to grow in dry places you shall not. Something must r for my purposes, in swamps, and you have to do it." They only be found where the seed will sprout.

has always seemed to the writer that it was one of the weak- es of many discussions in the study of development, that it generally from the individual standpoint. Nature cares only he individual, therefore questions of nutrition, fertilization, others are all viewed in their relation to the plant's "strug- or life." It seems rather that nature cares but little for the vidual, and stands ever ready to sacrifice the whole stock n it interferes with some purpose, which we have seldom able to fathom.

oming to the black-knot on the plum and cherry, we have a destructive American species *Sphæria (Plowrightia) mor-* , of little injury in its native state, thriving amazingly when n get as a host-plant the European domestic plum or Euro- n morello cherry. It thrives in these cases with a vigor it er shows at home. I have seen it in many parts of the east he wild dwarf choke-cherry, *Cerasus Virginiana;* in Colorado ts close ally *Cerasus demissa;* in North Carolina sparingly on *nus chicasa;* and in the White Mountains on the red cherry, *sus Pennsylvanica.* Recently in driving through various lo- ties on Mt. Desert Island, it was seen on the latter much more abundantly than in any of the former cases noted; but never anywhere with the amazing destructiveness it presents in these garden representatives of foreign species. In Pennsylvania, and probably other States, the cultivated cherry has been wild for over a hundred years. It is abundant, and in some cases so numerous as to be the chief element in a piece of woodland. But though it is evidently the foster-child of the cherry and not the plum, it prefers the plum and the sour cherry. The knot is rarely found on the wild cherry trees of the sweet cherry species. For all its long hereditary cherry taste, it rushes to the plum and the morello with as much avidity as if long-continued "environment" had induced the love.

It seems to be forgotten in many discussions of the black-knot that it is an American parasite, and that it may be found in quantities everywhere that the botanists look for it. When, therefore, the State of New York tries to "stamp it out" by legislating against garden trees affected with the fungus, it seems like bailing out the ocean with a bucket. Of course, cutting down and burning destroy many spores, but the wild nests send forth myriads of young to take the places of the domesticated foes destroyed. THOMAS MEEHAN.

Germantown, Pa.

Hectoring a Hawk.

EARLY one morning in August, while concealed in the grass and bushes of a White Mountain meadow, I saw an interesting encounter between a sharp-shinned hawk and a number of blue-jays and pigeon woodpeckers. Four of the woodpeckers were quietly preaning themselves in a dead pine by the lake shore, when suddenly a small and beautifully proportioned hawk dashed into their midst. They scattered shrieking, and found shelter in a fringe of woods near by. Their cries brought a kingbird to the spot, and the hawk was promptly attacked by the pugnacious fly-catcher and compelled to follow the flickers into concealment. The kingbird, satisfied with routing the hawk, hovered away over the meadow out of sight, and not long after the hawk reappeared and perched in the dead tree.

From time to time one or more of the woodpeckers came back to the tree and were at once charged by the hawk. In each instance they showed superior speed and escaped by their rapid flight. Their noise attracted the attention of a flock of about twenty blue-jays, and presently the blue-winged pirates came sailing over the meadow by twos and threes. As they neared the dead pine the hawk darted downward after their leader. The jay plunged quickly into the bushes, uttering wild cries and squawks, which were re-echoed by his companions. The hawk returned to the pine squealing pettishly, and the jays closed in upon him. They scaled the lower branches of the dead tree; they capped the neighboring maple saplings and alders; they watched for chances to brush past the hawk on his perch, and they assailed him with all the invective of their ample vocabulary. They threw themselves into the sport, as they seemed to regard it, with all the energy of boys playing "short fox."

The hawk took the matter much more in earnest; for he was hungry, and striving for a breakfast. Again and again he shot from the lofty branches of the pine, aiming first at one jay, then at another. By and by all the flickers returned, and added to the confusion by their cries and rapid excursions around the tree. The hawk in several instances seemed to lack but a single wing-beat of success, but the hour drew on without his making a capture. He grew weary. His plumage showed the chafing of the bushes. He chose lower and lower branches for his rests, and finally his sallies seemed directed more towards clearing the tree of noisy birds than to the capture of any one of them. At last he abandoned the dead pine and perched in trees having foliage. The jays followed him jeering, and he shifted his ground slowly until he gained the woods and disappeared. Then the jays crowded into the lower branches of the pine, hopped up from limb to limb until one after another gained the summit, and proved to the whole meadow that they had won the battle and fairly worried the hawk away.

The drama seemed to me to be significant in two ways; first, as

proving the daring of the jay in dealing with the most audacious of the bird-destroying hawks; second, in showing the assistance which an expert hawk, or a pair of hawks hunting together, must gain from the inclination of the jays and woodpeckers to hector them instead of seeking safety in retreat. The advantage which the owl enjoys in drawing other birds around him is well known, but it is not often that so good an illustration is given in the case of the hawk. FRANK BOLLES.

Chocorua, N.H., Aug. 20.

Tornado-Whirls in the Upper Clouds.

THIS morning I witnessed what seemed to me a very interesting and unusual phenomenon, which may be worthy of record. I noticed that a number of light flock clouds, moving north-east in the upper atmosphere, became, on reaching a certain small well-defined area, very ragged, and assumed the characteristic tornado forms. Many looked like jagged craters, reminding me strongly of the photographs of sun-spot whirls; some were honeycombed, and all were greatly torn. In the course of some ten minutes' observation, I saw at least a dozen such tornado-centres in cirro-cumulus, detached clouds floating almost directly above me. Such appearances in the lower clouds I have often observed, but this is the first time I remember seeing the upper clouds disturbed in this manner. The wind at the time on the surface of the earth was a forty-mile gale from the south-west, and there were frequent dust-whirls. HIRAM M. STANLEY.

Marquette, Mich., Aug. 18.

The Brutal Dove.

TWENTY-ONE years ago (Aug. 14, 1871), a mature, male dove flew into the house of Mr. Paul Closius of Chicago, and soon became quite domesticated. "Old Tom," as he is called, was rescued from the great fire of the following October, and later was given a female mate, which he pecked to death.

Thinking that it might be an instance of incompatibility, he was given another, which he tormented, neglected, and abused, until she also perished.

Naturalists are aware of the sentimental error which typifies gentleness in the dove, and have often remarked its ferocity. This instance also confirms the belief that doves are long-lived.

S. V. CLEVENGER.

Chicago, Aug. 17.

BOOK-REVIEWS.

Temperament, Disease, and Health. By FRENCH ENSOR CHADWICK. New York, G. P. Putnam's Sons. 85 p.

A REAL service is rendered science by those who emphasize the individual as well as environmental side of pathology. The tremendous development along certain lines of modern pathology should not be allowed to obscure the fact that predisposition of the organism is as potent a "cause" of disease as virulence of the germ.

The author of this book avows himself a special pleader on the very first page: "This little book is written primarily to put forward two ideas: First, that there is associated with temperament a specific rate of change; second, that the failure to keep up that rate, or, in other words, a failure to have elimination keep pace with accession of material, is the primal cause of organic disease." This thesis is maintained quite consistently throughout the book. "I thus venture to define what is known as 'organic disease' as a failure in rate of change. And, further, that, however associated, bacteria are the resultant rather that the causes of such diseases" (p. 16).

It will not be perfectly obvious to everyone that the phrase "failure in rate of change" brings us much nearer the real problem. The vexatious question will still be asked, Why should there be this failure to obtain adequate elimination of broken-down material? The final solution of this question of temperament must wait for a much deeper knowledge of the individual cell as well as of the cell-complex. Every attempt, however, at an explanation, although necessarily tentative and imperfect in character, serves its purpose in keeping the subject open and in stimulating research.

Errors of statement do not seem to be numerous. One strongly suspects, however, that the Mitchell mentioned on page 33 is no

other than the Prudden a few lines below. On this same page "Micro-coccus pyogenes ameus" is spoken of as "a bacillus."

Sometimes a curiously involved sentence is met with, as the following: "We are thus not fixed entities, as most of us are apt to consider ourselves; nor have we the gratification of even thinking ourselves here for the formerly supposed seven years at least" (p. 20). An over-critical reader, too, might take exception to the introduction of the personal element in the following: "Following the logic of these views, Dr. Koch's theory as to the possibility of the cure of consumption by an injection of a preparation of what may be called the dejecta of the bacillus of consumption must of necessity be an error, and I would say that I have held this view from the time of first publication of his supposed cure" (p. 68).

The History of Modern Education. By SAMUEL G. WILLIAMS. Syracuse, C. W. Bardeen. 12°. 403p. $1.50.

THIS work consists of a series of lectures which the author has been delivering for some years past as professor of the science and art of teaching in Cornell University. The entire course comprised also an account of ancient and mediæval education; but the part relating to modern times is the only part now published as being more generally interesting than the rest. Mr. Williams begins his narrative with the Renaissance, of which in its bearings on education he gives a brief but excellent account. In dealing with the religious Reformation and its results, he is not so happy; and throughout the book the subject of religious education receives less attention than it deserves. Mr. Williams treats the history of educational progress by centuries, showing what in his view were the leading characteristics of each century and its principal contributions to educational thought and practice; and this account of the general characteristics of the century is followed in each case by a sketch of the most prominent educators that the century produced. Throughout the book the author shows great impartiality and much good sense in his judgment of men and methods; and, what is no small merit in the present age, he is entirely free from hobbies. Some of our educators talk as if real education came into the world with Pestalozzi and Froebel, and that in the theory and practice of certain "advanced thinkers" of the present day it has reached perfection. Mr. Williams is under no such hallucination. He reminds his readers that time is the only sure test of historic events, and intimates that some of the ideas of the present day may be found hereafter to have no such importance as is now attached to them. Nevertheless, he devotes one of his longest and most elaborate chapters to the leading educational ideas of the nineteenth century, thus bringing his work down to the very decade in which we now live. He takes pains to show, however, that many things that are thought to be specially characteristic of the present age were anticipated by the thinkers and teachers of the sixteenth and seventeenth centuries. Mr. Williams's style is not always so clear as might be wished, and has no great literary merit; but it is generally intelligible, and its moral tone is good. On the whole, these lectures will serve a useful purpose as an introduction to the educational history of modern times.

Influenza. By CHARLES H. MERZ, M.D. Sandusky, O. 96 p.

IT would be manifestly unfair to expect too much of a "little treatise" that attempts to discuss a very special topic in a very general manner. The book was evidently written to meet the popular interest in its subject, and this fact alone explains perhaps the infelicities, not to say inaccuracies, of expression that are far too frequent on its pages. The history, etiology, symptoms, pathology, diagnosis, and prognosis, complications, and treatment of influenza are discussed with more or less success, the whole leaving a decided impression of hasty construction.

One is somewhat amazed, for example, when one reads, *apropos* of the phagocyte theory, of the odds arrayed against the Darwinian principle: "It is a fight between two forces and the survival of the fittest" (p. 23). On the same page the name of the eminent author of the doctrine of phagocytosis is hardly recognizable under the mask of "Metschini-Koft."

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

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N. D. C. HODGES,
874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
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Brain, A Few Characteristics of the Avian.
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Family Traits, Persistency of.
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Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
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Infant's Movements.
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Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
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Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, The New Method of Protecting Buildings from.
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Maya Codices, a Key to the Mystery of.
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Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

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SCIENCE

NEW YORK, SEPTEMBER 2, 1892.

THE IMMEDIATE WORK IN CHEMICAL SCIENCE.[1]

BY ALBERT B. PRESCOTT.

A DIVISION of science has a work of its own to do, a work that well might be done for its own sake, and still more must be done in payment of what is due to the other divisions. Each section of our association has its just task, and fidelity to this is an obligation to all the sections. Those engaged in any labor of science owe a debt to the world at large, and can be called to give an account of what they are doing, and what they have to do, that the truth may be shown on all sides.

If it be in my power to make the annual address of this meeting of any service at all to you who hear it — in your loyalty to the association — I would bring before you some account of the work that is wanted in the science of chemistry. Of what the chemists have done in the past the arts of industry speak more plainly than the words of any address. Of what chemists may do in the future it would be quite in vain that I should venture to predict. But of the nature of the work that is waiting in the chemical world at the present time I desire to say what I can, and I desire to speak in the interests of science in general. The interests of science, I am well assured, cannot be held indifferent to the interests of the public at large.

The Hidden Composition of Matter.

It is not a small task to find out how the matter of the universe is made. The task is hard, not because of the great quantity in which matter exists, nor by reason of the multiplicity of the kinds and compounds of matter, but rather from the obscurity under which the actual composition of matter is hidden from man. The physicists reach a conclusion that matter is an array of molecules, little things, not so large as a millionth of a millimeter in size, and the formation of these they leave to the work of the chemists. The smallest objects dealt with in science, their most distinct activities become known only by the widest exercise of inductive reason.

The New World of Discovery.

The realm of chemical action, the world within the molecules of matter, the abode of the chemical atoms, is indeed a new world and but little known. The speculative atoms of the ancients, mere mechanical divisions, prefiguring the molecules of modern science, yet gave no sign of the chemical atoms of this century, nor any account of what happens in a chemical change. A new field of knowledge was opened in 1774 by the discovery of oxygen, and entered upon in 1804 by the publications of Dalton, a region more remote and more difficult of access than was the unknown continent toward which Christopher Columbus set his sails three centuries earlier. The world within molecules has been open for only a hundred years. The sixteenth century was not long enough for an exploration of the continent of America, and the nineteenth has not been long enough for the undertaking of the chemists. When four centuries of search shall have been made in the world of chemical formation, then science should be ready to meet a congress of nations, to rejoice with the chemist upon the issue of his task.

It is well known that chemical labor has not been barren of returns. The products of chemical action, numbering thousands of thousands, have been sifted and measured and weighed. If you ask what happens in a common chemical change you can obtain direct answers. When coal burns in the air, how much oxygen is used up can be stated with a degree of exactness true to the first decimal of mass, perhaps to the second, yet questionable in the third. How much carbonic acid is made can be told in weight and in volume with approaching exactness. How much heat this chemical action is worth, how much light, how much electromotive force, what train-load of cars it can carry, how long it can make certain wheels go round,— for these questions chemists and physicists are ready. With how many metals carbonic acid will unite, how many ethers it can make into carbonates, into what classes of molecules a certain larger fragment of carbonic acid can be formed,—the incomplete records of these things already run through a great many volumes. These carboxylic bodies are open to productive studies, stimulated by various sorts of inquiry and demands of life. Such have been the gatherings of research. They have been slowly drawn into order, more slowly interpreted in meaning. The advance has been constant, deliberate, sometimes in doubt, always persisting and gradually gaining firmer ground. So chemistry has reached the period of definition. Its guiding theory has come to be realized.

The Central Truth of this Science.

"The atomic theory" has more and more plainly appeared to be the central and vital truth of chemical science. As a working hypothesis it has directed abstruse research through difficult ways to open accomplishment in vivid reality. As a system of knowledge, it has more than kept pace with the rate of invention. As a pholosophy, it is in touch with profound truth in physics, in the mineral kingdom, and in the functions of living bodies. As a language, it has been a necessity of man in dealing with chemical events. Something might have been done, no doubt, without it, had it been possible to keep it out of the chemical mind. But with a knowledge of the primary elements of matter, as held at the beginning of this century, some theory of chemical atoms was inevitable. And whatever theory might have been adopted, its use in investigation would have drawn it with a certainty into the essential features of the theory now established. It states the constitution of matter in terms that stand for things as they are made. The mathematician may choose the ratio of numerical notation, whether the ratio of ten or some other. But the chemist must find existing ratios of atomic and molecular mass, with such degree of exactness as he can attain. Chemical notation, the index of the atomic system, is imperfect, as science is incomplete. However defective, it is the resultant of a multitude of facts. The atomic theory has come to be more than facile language, more than lucid classification, more than working hypothesis, it is the definition of the known truth in the existence of matter.

The chemical atom is known, however, for what it does, rather than for what it is. It is known as a centre of action, a factor of influence, an agent of power. It is identified by its responses, and measured by its energies. Concealed as it is, each atom has given proof of its own part in the structure of a molecule. Proofs of position, not in space but in action, as related to other atoms, have been obtained by a multitude of workers with the greatest advantage. The arrangement of the atoms in space, however, is another and later question, not involved in the general studies of structure. But even this question has arisen upon its own chemical evidences for certain bodies, so that "the configuration" of the molecule has become an object of active research.

Known for what it does, the atom is not clearly known for what it is. Chemists, at any rate, are concerned mainly with what can be made out of atoms, not with what atoms can be made of. Whatever they are, and by whatever force of motion it is that they unite with each other, we define them by their effects. Through their effects they are classified in the rank and file of the periodic

[1] Address of the retiring president of the American Association at Rochester, August, 1892.

system. The physicists, however, do not stop short of the philosophical study of the atom itself. As a vibratory body its movements have been under mathematical calculations; as a vortex ring its pulsations have been assumed to agree with its combining power. As an operating magnet its interaction with other like magnets has been predicated as the method of valence. There are, as I am directly assured, physicists of penetration and prudence now looking with confidence to studies of the magnetic relations of atoms to each other.[1] Moreover, another company of workers, the chemists of geometric isomerism, assume a configuration of the atoms, in accord with that of the molecule.

Hypotheses to be Held Apart.

The stimulating truth of the atomic constitution of the molecule, a great truth in elastic touch with all science, excites numerous hypotheses, which, however profitable they may be, are to be stoutly held at a distance from the truth itself. Such are the hypotheses of molecular aggregation into crystals and other mineral forms. Such are the biological theories of molecules polymerizing into cells, and of vitality as a chemical property of the molecule. Such are the questions of the nature of atoms, and the genesis of the elements as they are now known,—questions on the border of metaphysics. Let all these be held distinct from the primary law of the atomic constitution of simple molecules in gaseous bodies, an essential principle in an exact science. The chemist should have the comfortable assurance, every day, as he plies his balance of precision, that the atom-made molecules are there, in their several ratios of quantity, however many unsettled questions may lie around about them. Knowledge of molecular structure makes chemistry a science, nourishing to the reason, giving dominion over matter, for beneficence to life.

Men Who Make Science.

Every chemical pursuit receives strength from every advance in the knowledge of the molecule. And to this knowledge, none the less, every chemical pursuit contributes. The analysis of a mineral, whether done for economic ends or not, may furnish a distinct contribution toward atomic valence. The further examination of steel in the cables of a suspension bridge is liable to lead to unexpected evidence upon polymeric unions. Rothamsted Farm, where ten years is not a long time for the holding of an experiment, yields to us a classic history of the behavior of nitrogen, a history from which we correct our theories. The analysis of butter for its substitutes has done something to set us right upon the structure of the glycerides. Clinical inspection of the functions of the living body fain finds a record of molecular transformations too difficult for the laboratory. The efforts of pharmaceutical manufacture stimulate new orders of chemical combination. The revision of the pharmacopœia every ten years points out a humiliating number of scattered errors in the published constants on which science depends. The duty of the engineer, in his scrutiny of the quality of lubricating oils, brings a more critical inquiry into the laws of molecular movement. There is not time to mention the many professions and pursuits of men who contribute toward the principles of chemistry and hold a share therein. If it be the part of pure science to find the law of action in nature, it is the part of applied science both to contribute facts and to put theory to the larger proof. In the words of one who has placed industry in the greatest of its debts to philosophic research, W. H. Perkin, "There is no chasm between pure and applied science, they do not even stand side by side, but are linked together." So in all branches of chemistry, whether it be termed applied or not, the best workers are the most strongly bound as one, in their dependance upon what is known of the structure of the molecule.

Waiting for Workers.

Studies of structure were never before so inviting. In this direction, and in that, especial opportunities appear. Moreover, the actual worker here and there breaks into unexpected paths of promise. Certainly the sugar group is presenting to the chemist an open way from simple alcohols on through to the cell substances of the vegetable world. And nothing anywhere could be more suggestive than the extremely simple unions of nitrogen lately discovered. They are likely to elucidate linkings of this element in great classes of carbon compounds, all significant in general chemistry. Then certain comparative studies have new attractions. As halogens have been upon trial side by side with each other, so, for instance, silicon must be put through its paces with carbon, and phosphorus with nitrogen. Presently, also, the limits of molecular mass, in polymers and in unions with water, are to be nearer approached from the chemical side, as well as from the side of physics, in that attractive but perplexing borderground between affinity and the states of aggregation.

And all for Mankind.

Such is the extent and such the diversity of chemical labor at present that every man must put limits to the range of his study. The members of a society or section of chemistry, coming together to hear each other's researches, are better able, for the most part, to listen for instruction than for criticism. Still less prepared for hasty judgment are those who do not come together in societies at all. Even men of eminent learning must omit large parts of the subject, if it be permitted to speak of chemistry as a single subject. These considerations admonish us to be liberal. When metallurgical chemistry cultivates skepticism as to the work upon atomic closed chains, it is a culture not the most liberal. When a devotee of organic synthesis puts a low value upon analytic work, he takes a very narrow view of chemical studies. When the chemist who is in educational service disparages investigations done in industrial service, he exercises a pitiful brevity of wisdom.

The pride of pure science is justified in this, that its truth is for the nurture of man. And the ambition of industrial art is honored in this, its skill gives strength to man. It is the obligation of science to bring the resources of the earth, its vegetation and its animal life, into the full service of man, making the knowledge of creation a rich portion of his inheritance, in mind and estate, in reason and in conduct, for life present and life to come. To know creation is to be taught of God.

The Means of Unification.

I have spoken of the century of beginning chemical labor, and have referred to the divisions and specialties of chemical study. What can I say of the means of uniting the earlier and later years of the past, as well as the separated pursuits of the present, in one mobile working force? Societies of science are among these means, and it becomes us to magnify their office. For them, however, all that we can do is worth more than all we can say. And there are other means, even more effective than associations. Most necessary of all the means of unification in science is the use of its literature.

It is by published communications that the worker is enabled to begin, not where the first investigation began, but where the last one left off. The enthusiast who lacks the patience to consult books, presuming to start anew all by himself in science, has need to get on faster than Antoine L. Lavoisier did when he began, an associate of the French Academy in 1768. He of immortal memory, after fifteen eventful years of momentous labor, reached only such a combustion of hydrogen as makes a very simple class-experiment at present. But, however early in chemical discovery, Lavoisier availed himself of contemporaries. They found oxygen, he learned oxidation: one great man was not enough, in 1774, both to reveal this element and show what part it takes in the formation of matter. The honor of Lavoisier is by no means the less that he used the results of others, it might have been the more had he given their results a more explicit mention. Men of the largest original power make the most of the results of other men. Discoverers do not neglect previous achievement, however it may appear in biography. The masters of science are under the limitations of their age. Had Joseph Priestley lived in the seventeenth century he had not discovered oxygen. Had August Kekulé worked in the period of Berzelius, some other

[1] "The results of molecular physics point unmistakably to the atom as a magnet, in its chemical activities."—A. E. Dolbear, in a personal communication.

man would have set forth the closed chain of carbon combination, and Kekulé, we may be sure, would have done something else to clarify chemistry. Such being the limitations of the masters, what contributions can be expected in this age from a worker who is without the literature of his subject?

The Cure for the Crank.

In many a town some solitary thinker is toiling intensely over some self-imposed problem, devoting to it such sincerity and strength as should be of real service, while still he obtains no recognition. Working without books, unaware of memoirs on the theme he loves, he tries the task of many with the strength of one. Such as he sometimes send communications to this association. An earnest worker, his utter isolation is quite enough to convert him into a crank. To every solitary investigator I should desire to say, get to a library of your subject, learn how to use its literature, and possess yourself of what there is on the theme of your choice, or else determine to give it up altogether. You may get on very well without college laboratories, you can survive it if unable to reach the meetings of men of learning, you can do without the counsel of an authority, but you can hardly be a contributor in science except you gain the use of its literature.

The Want of Original Memoirs.

First in importance to the investigator are the original memoirs of previous investigators. The chemical determinations of the century have been reported by their authors in the periodicals. The serials of the years, the continuous living repositories of all chemistry, at once the oldest and the latest of its publications, these must be accessible to the worker who would add to this science. A library for research is voluminous, and portions of it are said to be scarce, nevertheless it ought to be largely supplied. The laboratory itself is not more important than the library of science. In the public libraries of our cities, in all colleges now being established, the original literature of science ought to be planted. It is a wholesome literature, at once a stimulant and a corrective of that impulse to discovery that is frequent among the people of this country. That a good deal of it is in foreign languages is hardly a disadvantage; there ought to be some exercise for the modern tongues that even the public high schools are teaching. That the sets of standard journals are getting out of print is a somewhat infirm objection. They have no right to be out of print in these days when they give us twenty pages of blanket newspaper at breakfast, and offer us Scott's novels in full for less than the cost of a day's entertainment. As for the limited editions of the old sets, until reproduced by new types, they may be multiplied through photographic methods. When there is a due demand for the original literature of chemistry, a demand in accord with the prospective need for its use, the supply will come, let us believe, more nearly within the means of those who require it than it now does.

The Indexing of the Literature.

What I have said of the literature of one science can be said, in the main, of the literature of other sciences. And other things ought to be said of what is wanted to make the literature of science more accessible to consulting readers. A great deal of indexing is wanted. Systematic bibliography, both of previous and of current literature, would add a third to the productive power of a large number of workers. It would promote common acquaintance with the original communications of research, and a general demand for the serial sets. Topical bibliographies are of great service. In this regard I desire to ask attention to the annual reports, in this association for nine years past, of the committee on Indexing Chemical Literature, as well as to recent systematic undertakings in geology, and like movements in zoology and other sciences, also to the Index Medicus, as a continuous bibliography of current professional literature.

Societies and institutions of science may well act as patrons to the bibliography of research, the importance of which has been recognized by the fathers of this association. In 1855, Joseph Henry, then a past-president of this body, memorialized the British association for co-operation in bibliography, offering that aid of the Smithsonian Institution which has so often been afforded to publications of special service. The British association appointed a committee, who reported in 1857, after which the undertaking was proposed to the Royal Society. The Royal Society made an appeal to her Majesty's government, and obtained the necessary stipend. Such was the inception of the Royal Society Catalogue of scientific papers of this century, in eight quarto volumes, as issued in 1867 and 1877. Seriously curtailed from the generous plan of the committee who proposed it, limited to the single feature of an index of authors, it is nevertheless of great help in literary search. Before any list of papers, however, we must place a list of the serials that contain them, as registered by an active member of this association, an instance of industry and critical judgment. I refer to the well-known catalogue of scientific and technical periodicals, of about five thousand numbers, in publication from 1665 to 1882, together with the catalogue of chemical periodicals by the same author.[1]

Compilations of Science.

Allied to the much-needed service in bibliography, is the service in compilation of the Constants of Nature. In the preface of his dictionary of solubilities, in 1856, Professor Storer said, "that chemical science itself might gain many advantages if all known facts regarding solubility were gathered from their widely-scattered original sources into one special comprehensive work." That the time for the philosophical study of solution was near at hand has been verified by recent extended monographs on this subject. In like manner, Thomas Carnelley in England, and early and repeatedly our own Professor Clarke in the United States,[2] bringing multitudes of scattered results into co-ordination, have augmented the powers of chemical service.

What bibliography does for research, the Handwörterbuch does for education, and for technology. It makes science wieldy to the student, the teacher, and the artisan. The chief dictionaries of science, those of encyclopedic scope, ought to be provided generally in public libraries, as well as in the libraries of all high schools.[3] The science classes in preparatory schools should make acquaintance with scientific literature in this form. If scholars be assigned exercises which compel reference reading, they will gain a beginning of that accomplishment too often neglected, even in college, how to use books.

The Laboratory Method.

The library is a necessity of the laboratory. Indeed, there is much in common between what is called the laboratory method, and what might be called the library method, in college training. The educational laboratory was instituted by chemistry, first taking form under Liebig at Giessen only about fifty years ago. Experimental study has been adopted in one subject after another, until now the "laboratory method" is advocated in language and literature, in philosophy and law. It is to be hoped that chemistry will not fall behind in the later applications of "the new education" in which she took so early a part.

Urgency of the Chemical Task.

The advancement of chemical science is not confined to discovery, nor to education, nor to economic use. All of those interests it should embrace. To disparage one of them is injurious to the others. Indeed, they ought to have equal support. It

[1] Bolton's Catalogue of Scientific and Technical Periodicals (1885: Smithsonian) omits the serials of the societies, as these are the subject of Scudder's Catalogue of Scientific Serials (1879: Harvard Univ.). On the contrary, Bolton's Catalogue of Chemical Periodicals (1885: N. Y. Acad. Sci.) includes the publications of societies as well as other serials. Chemical technology is also represented in the last-named work.

[2] The service of compilation of this character is again indicated by this extract from Clarke's introduction to the first edition of his "Constants" (1873): "While engaged upon the study of some interesting points in theoretical chemistry, the compiler of the following tables had occasion to make frequent reference to the then existing lists of specific gravities. None of these, however, were complete enough. . . ."

[3] The statistics of school libraries in the United States are very meagre, the expenditures for them being included with that for apparatus. For libraries and apparatus of all common schools, both primary and secondary, the annual expenditure is set at $987,048, which is about seven-tenths of one per cent of the total expenditure for these schools.

would be idle to inquire into their respective advantages. This much, however, is evident enough, chemical work is extensive, and there is immediate want of it.

Various other branches of science are held back by the delay of chemistry. Many of the material resources of the world wait upon its progress. In the century just before us the demands upon the chemist are to be much greater than they have been. All the interests of life are calling for better chemical information. Men are wanting the truth. The biologist on the one hand, and the geologist on the other, are shaming us with interrogatories that ought to be answered. Philosophy lingers for the results of molecular inquiry. Moreover the people are asking direct questions about the food they are to eat, or not to eat, asking more in a day than the analyst is able to answer in a month. The nutritive sources of bodily power are not safe, in the midst of the reckless activity of commerce, unless a chemical safeguard be kept, a guard who must the better prepare himself for his duty.

The Subsistence of Science.

Now if the people at large can but gain a more true estimation of the bearing of chemical knowledge, and of the extent of the chemical undertaking, they will more liberally supply the sinews of thorough-going toil. It must be more widely understood that achievements of science, such as have already multiplied the hands of industry, do not come by chances of invention, nor by surprises of genius. It must be learned of these things that they come by breadth of study, by patience in experiment, and by the slow accumulations of numberless workers. And it must be made to appear that the downright labor of science actually depends upon means of daily subsistence. It must be brought home to men of affairs, that laboratories of seclusion with delicate apparatus, that libraries such as bring all workers together in effect, that these really cost something in the same dollars by which the products of industrial science are measured. Statistics of chemical industry are often used to give point to the claims of science. For instance, it can be said that this country, not making enough chemical wood-pulp, has paid over a million dollars a year for its importation; that Great Britain pays twelve million dollars a year for artificial fertilizers from without; that coal tar is no longer counted a by-product, having risen in its value to a par with coal gas. But these instances, as striking as numerous others, still tend to divert attention from the more general service of chemistry as it should be known in all the economies of civilization.

It is not for me to say what supplies are wanted for the work of chemists. These wants are stated, in quite definite terms, by a sufficient number of those who can speak for themselves. But if my voice could reach those who hold the supplies, I would plead a most considerate hearing of all chemical requisitions, and that a strong and generous policy may in all cases prevail in their behalf.

The Lesson of a Life.

If any event of the year is able to compel the attention of the world to the interests of research, it must be the notable close of that life of fifty years of enlarged chemical labor, announced from Berlin a few months ago. When thirty years of age, August Wilhelm von Hofmann, a native of Giessen and a pupil of Liebig, was called to work in London. Taking hold of the organic derivatives of ammonia, and presently adopting the new discoveries of Wurtz, he began those masterly contributions that appear to have been so many distinct steps toward a chemistry of nitrogen, such as manufacture and agriculture and medicine have thriven upon. In 1850 he opened a memoir in the Philosophical Transactions with these words, "the light now begins to dawn upon the chaos of collected facts." Since that time the coal-tar industry has risen and matured, medicine has learned to measure the treatment of disease, and agriculture to estimate the fertility of the earth. It seems impossible that so late as March of the present year, he was still sending his papers to the journals. If we could say something of what he has done, words would fail to say what he has caused others to do. And yet, let *it be heard in these* United States, without such a generous policy of expenditure for science as gave to Dr. Hofmann his training in Giessen, or brought him to London in 1848, or built for him laboratories in Bonn and Berlin, without such provision by the State, the fruits of his service would have been lost to the world. Aye, and for want of a like broad and prudent provision for research with higher education, in this country, other men of great love for science and great power of investigation every year fail of their rightful career for the service of mankind.

Endowments for Research.

For the prosecution of research, in the larger questions now before us, no training within the limitations of human life can be too broad or too deep. No provision of revenue, so far as of real use to science, can be too liberal. The truest investigation is the most prudent expenditure that can be made.

In respect to the support that is wanted for work in science, I have reason for speaking with confidence. If I go beyond the subject with which I began I do not go beyond the warrant of the association. This body has lately defined what its members may say, by creating a committee to receive endowments for the support of research.

There are men and women who have been so far rewarded, that great means of progress are in their hands, to be vigorously held for the best advantage. Strength is required to use large means, as well as to accumulate them. It is inevitable to wealth, that it shall be put to some sort of use, for without investment it dies. By scattered investment wealth loses personal force. The American association, in the conservative interests of learning, proposes certain effective investments in science. If it be not given to every plodding worker to be a promoter of discovery, such at all events is the privilege of wealth, under the authority of this association. If it be not the good fortune of every investigator to reach knowledge that is new, there are, every year, in every section of this body, workers of whom it is clear that they would reach some discovery of merit, if only the means of work could be granted them. Whosoever supplies the means fairly deserves and will receive a share in the results. It is quite with justice that the name of Elizabeth Thompson, the first of the patrons, has been associated with some twenty-one modest determinations of merit recognized by this association.

The Association as a Trustee.

"To procure for the labors of scientific men increased facilities" is one of the constitutional objects of this body. It is time for effectiveness towards this object. The association has established its character for sound judgment, for good working organization, and for representative public interest. It has earned its responsibility as the American trustee of undertakings in science.

"To give a stronger . . . impulse . . . to scientific research" is another declaration of what we ought to do. To this end larger endowments are necessary. And it will be strange if some clear-seeing man or woman does not put ten thousand dollars, or some multiple of it, into the charge of this body for some searching experimental inquiry now waiting for the material aid. The committee upon endowment is ready for consultation upon all required details.

"To give . . . more systematic direction to scientific research" is likewise stated as one of our objects. To this intent the organization of sections affords opportunities not surpassed. The discussions upon scientific papers give rise to a concord of competent opinions as to the direction of immediate work. And arrangements providing in advance for the discussion of vital questions, as formally moved at the last meeting, will in one way or another point out to suitable persons such lines of labor as will indeed give systematic direction to research.

In Fellowship.

In conclusion I may mention another, the most happy of the duties of the American association. It is to give the hand of hospitable fellowship to the several societies which year by year gather with us upon the same ground. Comrades in labor and in refreshment, their efforts reinforce us, their faces brighten our way. May they join us more and more in the companionship

that sweetens the severity of art. A meeting of good workers is a remembrance of pleasure, giving its zest to the aims of the year.

AMERICAN ASSOCIATION OF STATE WEATHER SERVICES.

A CONVENTION of representatives of State weather services was held in Rochester, N.Y., on Aug. 15 and 16, 1892, in conjunction with the forty-third meeting of the American Association for the Advancement of Science. The convention was called to order by Professor Mark W. Harrington, chief of the Weather Bureau, who made an address of welcome to the representatives present. He suggested certain important subjects for discussion, and appointed committees on permanent organization, programme, etc.

A permanent organization was effected, and the following officers were elected: President, Major H. H. C. Dunwoody; first vice-president, B. S. Pague of Oregon; second vice-president, G. M. Chappel of Iowa; secretary, R. E. Kerkam, chief of State Weather Service Division, Weather Bureau; and treasurer, W. L. Moore of Wisconson.

The title, American Association of State Weather Services, was adopted by the convention, and it was decided to hold annual conventions in future at the same time and place as those of the American Association for the Advancement of Science.

The following representatives were in attendance: The U. S. Department of Agriculture, Weather Bureau, being represented by Professor Mark W. Harrington, chief; Major H. H. C. Dunwoody, forecast official; Mr. R. E. Kerkam, chief of State Weather Service Division; Mr. N. B. Conger, inspector; and Mr. F. J. Randolph, stenographer; F. H. Clarke, Arkansas; J. A. Barwick, California; John Craig, Illinois; C. F. R. Wappenhans, Indiana; G. M. Chappel, Iowa; Frank Burke, Kentucky; E. A. Evans, Michigan; G. A. Lovelend, Nebraska; J. Warren Smith, New England; E. W. McGann, New Jersey; R. M. Hardinge and W. O. Kerr, New York; C. M. Strong, Ohio; B. S. Pague, Oregon; H. L. Ball, Pennsylvania; S. W. Glenn, South Dakota; G. N. Salisbury, Utah; J. N. Ryker, Virginia; and W. L. Moore, Wisconsin.

Many of the representatives who were unable to be present at the convention forwarded papers giving their views on various subjects of interest to be discussed.

The subject of instrument-shelters and a uniform manner of their exposure was debated, and it was the concensus of opinion that a uniform pattern of shelter should be adopted for use throughout the entire country. The subject was referred to a committee consisting of Messrs Smith, Moore, and Pague, with instructions to report as to the most suitable shelter and manner of exposure to be generally adopted by State weather services.

On the subject of whether the voluntary observers should be supplied with self-registering maximum and minimum thermometers, the prevailing opinion was that such instruments should be issued and used in determining temperature means and averages, wherever and whenever practicable. The old method of making readings at 7 A.M., 2 P.M., and 9 P.M. of the dry thermometer shall be continued whenever desired, but the means should be deduced from the self-registering thermometers where such instruments are in use.

As to the adoption of a form to cover the needs of a great majority of the voluntary observers who are supplied with dry or maximum and minimum thermometers and rain-gauges, it was decided to adopt a form which was suggested by the secretary, so arranged as to admit of making three or four copies, at one writing, by means of the indelible carbon process, thus saving the observers the copying of the form at the end of the month; the object of this arrangement being to give a copy of the monthly report to the office of the chief of the Weather Bureau, one to the office of the director of the State service, and one to be retained by the observer, and also to make such additional copies as he may desire to furnish to the local press, etc.

The forecasting of thunder-storms was the fourth subject discussed, and an interesting paper on this topic was read by the Wisconsin representative.

The proposition to print the weekly, monthly, and annual reports of the State weather services in a uniform manner was freely discussed. The desirability of uniform reports was generally admitted, but it was thought impracticable at this time to take any action in the matter, as a number of States have appropriated funds for printing reports according to definite size and style.

The discussion of the question of the best methods of signaling weather forecasts by display-men covered a wide range. The flag, the whistle, the semaphore, and the sphere, bomb, and flash-light systems were freely discussed, and an interesting paper was presented by the New England representative on the system of spherical bodies hoisted on a staff. This subject was referred to a committee composed of Messrs. Conger, Glenn, and Kerkam, for report at the earliest practicable date.

On the subject of inspection of voluntary observers' stations the decision was that each voluntary station should be inspected at least once each year, to keep up the interest of the voluntary observers and to enable the directors of State services to become thoroughly familiar with each station and its surroundings. It was recommended by the association that sufficient leave of absence be granted the Weather Bureau representative at each State service centre to enable him to make a tour of inspection.

Relative to the subject — the relations of State weather services to agricultural colleges and experiment stations — it was decided that, owing to the lack of telegraphic facilities and other means of disseminating weather information, it would not be practicable generally to have the central stations of the State weather services at such colleges or stations, but that a very close co-operation would be desirable.

The subject of an exhibit at the World's Fair was the last general subject discussed. It was decided that each State service should have its exhibit in the building set apart for the use of the State, and not to have the exhibits collected in the building for the use of the United States Weather Bureau.

Mr. E. T. Turner of New York and Mr. E. H. Nimmo of Michigan were elected to active membership in the association, and the following honorary members were also elected: E. F. Smith, California; Professor R. Ellsworth Call, Iowa; Charles C. Nauck, Arkansas; Professor William H. Niles, Massachusetts; G. H. Whitcher, New England; H. G. Reynolds, Michigan; H. F. Alciatore, Oregon; Major Richard V. Gaines, Virginia; Professor A. L. McRae, Missouri; C. F. Schneider, Michigan; Professor Louis McLouth, South Dakota; and all active voluntary observers of the United States Weather Bureau.

NOTES AND NEWS.

MR. THEODOR GRAF of Vienna has in his possession a remarkable treasure in the shape of fragments of the Bible recently found in Egypt. They consist of a portion of Zechariah, chapters iv.-xiv., in the shape of a papyrus book in a fair state of preservation. The fragment is that of a Greek translation, and from the shape of the letters the MS. would appear to belong to the fourth century, making it the oldest Bible MS. thus far discovered. The same papyrus also contains fragments of Malachi.

— The current number of the *Zeitschrift der Deutschen Morgenländischen Gesellschaft* contains an article of the highest importance by the distinguished Egyptologist, Dr. Adolf Erman. He discusses in a most cautious way the supposed relationship of the Egyptian with the Semitic languages. A careful examination of the consonants and vowels, the accent, the pronominal suffixes, the pronouns, and the demonstratives, the nouns, adjectives, numerals, and verbs, as well as of the syntax, leads to the conclusion that on the grammatical side there is sufficient evidence to warrant the assertion of a relationship between Egyptian and Semitic. An examination of the vocabularies shows only a comparatively small number of words which are identical, but this number will probably be increased when the laws of phonetic change come to be better understood. The conclusions of Professor Erman, if accepted, will be epoch-making, since they will establish the identity of the culture of the Nile and Mesopotamian valleys.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and one hundred copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

CREMATION OF CHOLERA CORPSES.

BY ALBERT S. ASHMEAD, M.D., LATE FOREIGN MEDICAL DIRECTOR OF TOKIO HOSPITAL, TOKIO, JAPAN.

JAPAN has almost everything, or believes that it has almost everything, to learn from us; but there are a few things which it would be wise for us to consent to learn from Japan. The Japanese, a prey from time to time, like all Oriental countries, to cholera epidemics, and, having the cholera always with them endemically, have early found out that the cholera corpses should be burned.

There are in the city of Tokio six crematories. They are not only destined to the incineration of cholera corpses; for cremation is imposed as a religious duty by a number of Buddhist sects. In the oldest cemetery in Japan, that of Koya-san, near the great water-falls in Wakayama-Ken, 700 English miles south of Tokio, cremation has been practised, as is generally believed, as a religious rite these 1200 years.

Naturally, the rite of incineration had no difficulty in that country in passing from the religious conception to a sanitary application. The first sanitary cremation edict was issued by the government in 1718, during an epidemic which seems to have been very destructive. Japanese documents speak of that period with trembling awe; 80,000 a month died in the city of Yedo; undertakers could not make coffins fast enough: grave-yards were all filled up. The Japanese are singularly struck by the idea that the men who worked at the cremation furnaces after sunset were themselves changed into smoke before sunrise, and that the tomb stone cutters of a day found (*horribile visu!*) their own names carved on the morrow's tombstones! Finally the priests of all the sects united in asking for a general application of the cremation rite; ashes alone, they said, should be buried; at every burial-ground mountains of casks discouraged the diligence of the grave-digger; a multitude of corpses (the Japanese documents have the simplicity to add that they were mostly poor persons) remained unburied for weeks. The Japanese have long believed that this was a cholera epidemic, the first that ravaged the *fertile sweet-flag plain;* but that is a delusion. Cholera paid them its first visit more than a hundred years later. It was then that the religious character departed once for all from the cremation rite; for the government, seeing that the fire was too slow, ordered the bodies, wrapt in mats and quick-lime, to be sunk into the sea; cremation ever after was only a sanitary operation.

In the past thirteen years there have been 456,080 reported cholera patients in the empire; of these 303,466 died, that is, 66½ per cent. Every one of these corpses has been burned. Under police regulations, in the city of Tokio, there may be eight public crematories (of course, this has nothing to do with the private establishment of each Buddhist burial-place), placed outside of the city-limits. The law requires that they shall be constructed of brick and large enough to burn at least twenty-five corpses at a time. Each furnace must have a chimney over thirty feet high. Each crematory is expected to have a separate furnace for burning discharges, and a separate disinfecting room. This furnace is to be of brick and capable of incinerating at least twenty-five casks (bushels) at a time; its chimney must be thirty feet high. The law requires further that the disinfecting compartment shall be divided into two spaces, one a bath-room, not for the corpses, of course, but for persons suspected of harboring the disease; the other a fumigating place. Cremation can only be performed from sunset to sunrise; the corpses are not stripped of their clothing, and are one and all accompanied by their burial certificate.

In the Buddhist cemeteries cremation is thus performed. The corpse is brought in a square wooden box or barrel (the regular Japanese coffin) in a sitting position, according to the national custom. A hole in the ground with sloping sides awaits it, at the bottom of which are two stones, upright and parallel; across the top of these stones fire-wood and charcoal are piled. Around the corpse, placed upon the pile, a circular wall is built up, formed of rice-straw and chaff, perhaps to a height of five or six feet, and the wall itself is wrapped in wet matting, which during the whole operation is continually moistened. The fire is kept up during twelve hours, after which the ashes and bones are picked up with chop-sticks by the oldest representative of the family, enclosed in a funeral urn, and buried after seven days of various religious observances.

It is most regrettable that cremation has not with us that religious origin which recommended it first to the Japanese. Reason and good sense have never proved such strong foundations; otherwise the advisability of the cremation of cholera corpses would have occurred to us long ago. It is useless to object that these precautions do not preserve Japan from cholera epidemics. The disease is kept up there by causes which cannot be reached by cremation. The houses are built in unhealthy places, they are squalid and in every way insalubrious; the water is wretched, infected by impurities dropping from ill-kept closets. There would be no end, if we tried to enumerate all the causes of disease, which render the wisest precautions useless. None of these causes exists in our western countries, and the cremation of cholera corpses would have yielded its whole sanitary benefit. If we burned our corpses, the bacillus would be destroyed effectively; in Japan, the dejections of the living, contaminating the well-water, the system of promiscuous public bathing, etc., keep it alive in spite of the cremation.

When the cholera, some years back, made its appearance, not in New York, indeed, but in its harbor,—that is, in the quarantine station,—having been brought by an Italian

immigrant ship, the dead were buried on Staten Island at the quarantine burying-grounds. If we were as ready to profit by past observation as we ought to be, cremation would have been introduced then and there. For in 1866, when some cholera immigrants had been buried on Ward's Island, an epidemic started almost immediately in the part of the city nearest to that burial-ground; there, in 93d Street and 3d Avenue, the first case occurred. This was certainly a fact to be taken into serious consideration. No man interested in the health of his fellows will be content to say that this was only chance. And if it is more than chance, why then has it never been proposed to prevent the propagation of the disease by fire, as other peoples have long been accustomed to do?

There are four rules, by observing which we can absolutely prevent cholera from setting foot on this continent: —

1. Let the drinking-water be perfectly isolated; that is, keep the cholera germs from the drinking-water.

2. Let the fœces and other discharges be disinfected with quick-lime or common white-wash. This is, by the way, what Professor Koch recommended to the Central Sanitary Board of Japan.

3. Let the clothing be disinfected with dry heat, 100° C., and afterwards with steam.

4. Finally, let the cholera corpse be cremated instead of buried.

4 King Street, New York.

ACORN-EATING BIRDS.

BY MORRIS GIBBS, M.D.

IN Michigan there are, to my knowledge, six species of birds which feed on acorns. Of these, the passenger-pigeon and mourning-dove swallow the acorn entire, with its shell intact, only removing the cup or rough outside covering. The white-bellied nut-hatch occasionally hoards the acorns away, and only draws on its store after some months, and when the firm shelly covering readily gives away to its sharp, prying bill. The other three are the well-known blue-jay, common crow-blackbird, and red-headed woodpecker. The methods employed by these birds in opening an acorn are so entirely different, that a description may not be uninteresting to your readers.

Kalamazoo City is nestled in a valley which was once nearly filled with oak trees, and large numbers of the burr-oak, *Quercus macrocarpa*, are still standing. The acorns of these trees, sometimes called over-cup or mossy-cup, are nearly ripe and are now falling, and the birds which feed on them gather to satisfy their love for the nutritious kernels. So far as I am able to learn, the birds, except in rare instances, do not pick the acorns from the tree, but have to content themselves with the fallen fruit. Occasionally one sees a bird attempting to pick an acorn, but it is rarely a success, as the twigs are small and do not accommodate the swaying bird well, and, moreover, at this season of the year, many acorns are still strongly attached.

The red-head, deigning to descend to the ground, seizes an acorn, and flying with it in its bill to a spot where there is a small cavity in the dead portion of a trunk, or to a crevice in the bark, immediately begins to hammer it with its sharp-pointed bill. In a couple of strokes it has removed the outer shell or cup, and at once attacks the still green-colored shell which directly surrounds the meat. The inside, or shell proper, quickly gives way, usually nearly in halves, and the woodpecker enjoys the kernel. The red-head rarely comes into the city, and is never here continuously, but at this season he is quite often seen and heard, and I have thought that the acorns brought him. The woodpeckers are as nearly strict insect-feeders as any birds we have, unless an exception is made of the swifts and swallows, yet here is an instance of a varied diet. However, the red-head is quickly satisfied in the acorn line, and soon begins circling the trunk, or more often limbs, for his legitimate food.

The blackbird confines himself to the ground in his efforts for acorn meats, and I have yet to see him in a tree with one. Walking up sedately to an acorn, and making no effort to seize or confine it, it strikes savagely and almost aimlessly. Its bill frequently glances, and the splintered shell dances about, until at last a huge piece of the kernel is dragged out, after which the bird leaves for other quarters or begins on another acorn.

The jay swoops down with flaunting blue wings, and, seizing the largest acorn on the ground, flies to the nearest convenient limb or onto the decayed ridge-board of an adjacent building. There, firmly pressing the nut between his big, black feet, he hammers away with a vengeance, and quickly tears off nearly half of the shell, after which it proceeds to pick out the meat in small bits. The cup is often left nearly perfect, the jay never making an effort to secure the nut entire, which he could easily do.

Walking under the oaks, one can readily tell whether the woodpeckers, blackbirds, or jays have been at work among the acorns, by the appearance of the mutilated shell-remains lying about.

Kalamazoo, Michigan.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Intelligence of a Horse.

CAN a horse reason, or does he act solely from instinct? Many believe that he has reason and intelligence; others attribute all his acts to instinct. As a help to elucidate this question, I wish to present the readers of *Science* the following statement of facts based on long and close observation.

I have a horse, now nineteen years old, that I have owned thirteen years. I have used him all this time almost every day, harnessed to a buggy, in going back and forth to my office. He is very gentle, good-natured, and kind, and has never shown any vices. Soon after I commenced using him, I noticed that on Sundays, whenever I drove him down-town, he strongly insisted, by pulling on the lines, on going to the church where I had been in the habit of attending. I watched this disposition constantly after that, and on every Sunday since, when driven out, he has continued to do the same thing, and, if left to his own will, invariably goes to the church and stops. I thought it possible that he was guided by the ringing of the church bells, and tested him by driving him down-town at all hours of the day, before and after the ringing of the bells; but the result was the same. He invariably insisted on going to church on that day, no matter how often I drove him down-town. My office is one block west and one north of the church, and a half-mile west of my residence. In going to church I usually turn south one block east of the office, but sometimes go around by the office, where I usually drive him every morning and afternoon. In going to my office he never offers to go to the church except on Sunday, but on that day he invariably begins to turn south to the street leading to the church, from fifty to a hundred feet before reaching the crossing, and, if not checked, turns into the street and hurries to the church. He has kept this up for at least twelve years. He never does this on any other day than Sunday. In bad weather or in good weather it is the same, although at the office much of the time he has had stable protection from bad weather. On week-days he often insists on going to the stable in bad weather; but on Sunday, even when I compel him to go by the way of the stable, he pulls over to the opposite side of the street, and hurries on to the church, if permitted, though he may have to stand out in the cold, rain, or snow.

Sometimes, from one cause or another, he has not been taken away from home from one to four weeks, and I supposed that he would lose the run of time, or at least show some hesitation and uncertainty; but not so. On the first Sunday after I drove him out, he insisted, as before, on going to church. He never offers to go

there any other day of the week, though the church bells are rung and numerous services are held nearly every day.

If on Sunday I go to the post-office, which is on the north-west corner of the street-crossing, where we usually turn south to the church, instead of going from there direct to the office as on other days, he turns to the south and goes to the church. He never willingly goes to the post-office on Sunday, but always stops there on week-days of his own accord, if permitted. Many times I have taken other streets on Sunday and approached the church from other directions; but in all cases, when left free, he invariably takes the first street leading to the church. I have experimented with him very largely in this respect, with a view to learning how he keeps the run of time, but am unable to satisfactorily account for it. I have also observed and experimented with him in a great many other ways, and have taught him to know the meaning of many words.

When alarmed at anything, he looks back to me with a frightened look, as much as to say, "Will it harm me?" On my saying to him, "All right, go on," he moves on. If much frightened, he will repeatedly look back for assurance from me.

He knows the meaning of many words, such as office, post-office, school-house, mill, farm, cemetery, church, apple, corn, grass, water, and many others. The fact that he knows the meaning of these words, or at least attaches a meaning to them, I have tested many times in many ways, the relation of which would make this paper too long. When his corn is about used up, if I speak of it to him and say, "Deck, your corn is out; you must go to the mill," even before starting from home, he turns in at the mill as I go by, and goes up to the office door where I have been in the habit of ordering his food. Sometimes I have forgotten it by the time I come opposite the mill, and would have gone by; but he has not forgotten it, and turns in. If I say to him, "Do you want an apple?" of which he is very fond, he puts on the most wistful look and does all in his power to say that he does; and if the apple is not produced at once, he begins to explore my pockets and clothing with his nose in search of an apple suspected to be concealed about my person. If I say to him, "Do you want grass?" he at once shows that he expects to be turned out upon pasture.

He also knows a number of people by name and where they reside; and if told to stop at the residence of one of them, naming him, he will do so, without any guiding.

These are only a few of the many evidences of his intelligence. Hundreds of examples might be given showing his knowledge and intelligence, and that he gives very close attention to and understands what is said to him.

Do not these facts strongly indicate that the horse has more than mere instinct, that he reasons; that out of the store-house of his knowledge and experience he forms conclusions, thoughts, purposes, and plans? He understands certain symbols, such as words; he keeps the run of time and knows uniformly when Sunday comes, for he has not made a mistake in this respect for more than twelve years past; he uses many and diverse means for making his wants known.

Instinct is supposed to imply inherited knowledge of objects and relations in respect to which it is exercised, and will usually, if not always, operate where there is no experience to guide. But this horse's knowledge, in these respects, has not been inherited, but is acquired. He never was at this church till he was six years old. His mother was probably never there. In instinct there is no necessary knowledge of means and ends implied, though such knowledge may be present, but instinct is always manifested in like manner by all individuals of the same species, under like circumstances, which is certainly not true in this case.

Hence I infer that this horse does reason; that he has a high degree of intelligence, even much more than he is able to make us understand and appreciate.

But does the fact of his observing Sunday imply a moral sense? Why does he seek to go to the church on that day? It has been said that animals do reasonable things without having the gift of reason; that they do things involving distant foresight without having any knowledge of the future; that they work for that which is to be without seeing or feeling anything beyond what is; that they enjoy, but do not understand; that reason works upon and through them, but is not in them. The facts that I have related and observed make me greatly doubt many of these statements. I find it hard to sharply define the limits between instinct and reason. The facts that I have related indicate reason, intelligence, motives, and the formulation of plans, methods, and schemes for carrying out preconceived purposes. Some of the acts, at least, indicate pure reason based upon former and remembered sensations, perceptions, and knowledge, and the purpose to gratify merely mental desires.

What motive does this horse have for going to church every Sunday, even at a sacrifice sometimes? It is not for rest, it is not shelter, it is not feed, it is not company, it is not to gratify any merely physical want, for all these things he has elsewhere every day. Is it not purely an intellectual or moral want that he seeks to gratify? He stands near the church door, hears much of the exercises, especially the singing, and will remain, almost without motion, whether tied or not, till the services are over, and I am ready to go home. But it cannot be for the mere speaking and singing that he hears there, for he often hears speaking, singing, concerts, the Salvation Army, and music of various kinds while he stands tied at the office on the public square; but none of these take the place of his church-going.

These facts I have given as tending to illustrate and explain animal intelligence. I have given only such as I have verified many times.

T. B. REDDING.

Newcastle, Ind., Aug. 22.

The English Sparrow and our Native Birds.

I AM obliged to send a different report regarding the influence of the English sparrow on the presence of native wild birds in a country village.

In 1874–5 there were not more than one or two pairs of these foreigners in the village of Fort Edward. In less than ten years they numbered hundreds, and long since seemed to have reached the limit of the winter-food capacity of the district, being distributed among the farmers' barns as well as in the village.

Before their arrival the chipping sparrow was plentiful; now it is seldom seen. The song-sparrow nested frequently; I have not seen them in the village as residents for several years. Catbirds were not infrequent; now they come in the early spring for a few days, then disappear, though thickets on the river-bank near the town are especially favorable. Summer yellow-birds built often in the low trees; I have not seen a single resident this summer. Wilson's thrush also was an occasional resident; none have been here for four or five years. The vireo used to build and sing in the elms and apple-trees; they are very rare indeed now. The wood-phœbes, though their early morning song is still heard, are few in number where they were once abundant. The robin is almost the sole bird, in so far as I have observed, that holds his own regardless. I will except also the black martin, or house martin, who manages to turn out about four-fifths of the sparrows. The other fifth so blockade the entrance to the holes with their nests that the martin is effectually shut out. Bluebirds too have left us, they are too weak, and too refined in their tastes to long live neighbors to such low-lived little beasts as the filth-loving, quarrelsome, meddlesome sparrows.

I have a box in my garden which the sparrows do not dare to occupy, for they know me. But the bluebirds, who formerly nested there, come occasionally in the spring, have a tilt or two in the trees with the sparrows, then leave in disgust. Probably no native wild bird begins to have the mental development and quick wit possessed by the English sparrow. But all his wit runs to saving his precious self from danger and from exertion; hence he will, without doubt, persist. See, for example, how little strength he uses in avoiding danger. He just gets beyond range of whip or stone, and sits and calmly looks you over. He avoids poison with as much foresight as you could, and will starve rather than eat suspected food. He rolls in mud and dirt, oblivious of all else, just for the fun of having a lively squabble with some fellow, and when it is over is pecking about in the next ten seconds as if nothing had happened.

A half-dozen, or dozen, males chase down a female, roll her in the dust or mud, as the case may be, and, despite the frantic fighting back, pull her tail, peck her wings, pinch her with their claws, and when the tormenters are tired out and she panting with exhaustion, the whole party adjourn to a convenient heap of dung, and, in less time than it is spoken, the joke seems forgotten.

They drive away birds larger and more courageous than themselves, if they are perching birds, by following at their heels, and doubtless also making uncomplimentary remarks. Watch the arrival of the first robin, and see the three or four hoodlums follow him from tree to tree for the first week after his coming. Not one dares touch him, but they make his life miserable.

The song sparrow, though he will vanquish the Englishman every time, soon tires of being tagged from bush to tree, and leaves in disgust. The same is true of the catbird, and to some extent of the oriole, which is also less common by half. I have seen them pull a "chippy's" nest to pieces during the owner's absence out of pure mischief, and I presume they do the same to the nests of other birds.

It is difficult to see what there is to recommend the little villain, and the man who introduced him should be classed with the man who introduced rabbits into Australia. X.

Fort Edward, Aug. 22.

Celestial Photomicrography.

STELLAR photography has advanced enough to justify the hope that, by the next opposition of Mars, some means of scrutinizing his landscape more closely may be found. If microphotography and its associated science, photomicrography, are pushed on parallel lines with stellar photography by co-operating specialists who can appreciate the requirements in both fields, something valuable may result.

The possibility of an Atlantic cable was laughed at by good electricians, and astronomers despair of overcoming the difficulties presented by diffraction, irradiation, chromatic and atmospheric blurrings, and light absorption; but these matters have been conquered in many respects in telescopy and general photography.

Materials that will afford the densest homogeneity of surface should be sought for, upon which the photographs can be taken, to be later scrutinized with microscopic lenses. It may be possible to arrange a battery of microscopes to take enlarged camera-lucida photographs, which in turn may be enlarged by "solar prints;" and if surfaces can be invented or discovered smooth and continuous enough to admit of these successive enlargements without breaking up the details, we may possibly capture the Martial men in the act of filling Schiaparelli's canals, and otherwise observe what their estimated five million years of seniority over us affords them. S. V. CLEVENGER.

Chicago, Aug. 21.

As to the "Extinction" of the American Horse.

IN 1881, in the *Kansas City Review*, E. L. Berthoud pointed out the fact that, in maps drawn up by Sebastian Cabot (who went in 1527 to the east coast of South America) to show his discoveries, at the head of La Plata, with figures of other animals he gives that of the horse.

This fact, as thus put on such indubitable record, is accepted by scientists, including Heilprin, Wilckins, and Flower. The latter, in his manual on "The Horse" (1891), says: "The usual statement as to the complete extinction of the horse in America is thus qualified, as there is a possibility of the animals having still existed, in a wild state, in some parts of the continent remote from that which was first visited by the Spaniards, where they were certainly unknown. It has been suggested that the horses which were found by Cabot in La Plata in 1530 cannot have been introduced."

The above is surely of great interest, and is worthy of repetition. The writer has come across two statements, which, taken in connection with the above, appear to be even more important and significant, and may profitably be given wider prominence. As they are not generally known, they are given for the purpose of their receiving the attention that they seem to deserve.

In the volume of the Naturalist's Library, entitled "The Horse," by Major Hamilton-Smith, published in London in 1841, appears the following: "Several recent travellers in the northern portion of that continent [America] question the race of horses now so abundant being imported subsequent to the discovery by Columbus" (p. 147).

In "The History and Delineation of the Horse," by the noted authority, John Lawrence, published in London, 1809, the following sentence occurs: "The non-existence of the horse in America, previous to its discovery by Europeans, has, however, been disputed; but I recollect not by whom, or upon what ground" (p. 7). ROBT. C. AULD.

Some Notes on The Rochester Meeting.

WHERE did the scientists come from? The first four hundred names on the register show their geographical distribution as follows, by States: New York, 119; Washington, D.C., 44; Ohio, 35; Pennsylvania, 24; Massachusetts, 22; Indiana, 19; Illinois, 18; Canada, 17; Connecticut, 13; Michigan, 11; Wisconsin, 10; Iowa, 10; New Jersey, 9; Missouri, 7; Maryland, 4; Kentucky, 4; Tennessee, 4; Alabama, 4; Maine, 3; Vermont, 3; California, 3; New Hampshire, Rhode Island, Minnesota, Georgia, and Florida, each 2; Virginia, West Virginia, North Carolina, Mississippi, Louisiana, and Texas, each 1.

More than one-fourth of the whole number came from New York State. Of the 119 from the State, 32 were from New York City and Brooklyn, 24 from Rochester, and 18 from Ithaca. Washington, D.C., furnished 44, the largest number from any one city. The whole of New England sent only 45, although it has until recently been considered the scientific headquarters of the country, and is more thickly dotted with colleges than any other section. Cornell University was more largely represented than any other University, while Princeton was not represented at all; the New Jersey delegation coming chiefly from Rutgers and Stevens. The central western States showed up handsomely, and twelve southern States sent from one to four men each; while from the States and Territories west of the Missouri River there was no representation at all, except three from California.

Geographically, therefore, the scientists who attended the meeting are not evenly distributed. New York State sent far more than its quota, even after deducting the attendance from Rochester, the place of meeting. In proportion to its population, Ohio sent twice as many as Pennsylvania, although its average distance from Rochester is greater.

The programme for the third day of the meeting (Friday) contained a list of 146 members that had been elected since the Washington meeting, with symbols expressing their affiliations with the different sections. The majority of these new members specified their intention of joining one section only, but many named two sections, and some three. Twelve members did not specify any section. The following shows the apportionment of these new members among the sections: —

Section A, Mathematics and Astronomy,	14
" B, Physics,	15
" C, Chemistry,	21
" D, Mechanical Science and Engineering,	5
" E, Geology and Geography,	21
" F, Biology,	42
" H, Anthropology,	21
" I, Economic Science and Statistics,	23
Totals, including duplications,	162

The several branches of science are therefore far from being equally represented in the new membership. The branch of mechanical and engineering science, which in the country at large is developing by leaps and bounds, sends to the association only one-fourth as many members as chemistry and one-eighth as many as biology. The latter sends more new members than the three ap-

plied sciences, chemistry, physics, and mechanical science, put together. Geology, geography, biology, and anthropology furnish more than half of all the new members.

In the reading of papers before the sections, the same want of proportion was shown. Section F, biology, held sessions on both Thursday and Friday, morning and afternoon; and 32 papers were listed for those two days. Section I, economic science and statistics, held a session on Thursday afternoon only, and none on Friday, and only 4 papers were listed, and of these the only paper that was statistical was a five minute paper on Statistics of the Salvation Army! The Section of Biology, in fact, is so overcrowded with papers and discussions that it was decided to split it into two sections, F, Zoology, and G, Botany; while a proposition was made, although not entertained, to consolidate sections D and I into one section.

At the recent meeting of the British Association, it is reported that there were 2,500 members in attendance. At the Rochester meeting there were less than 500.

From the above facts, it appears that the American Association is not a fairly representative body of American scientific men. In it the physical sciences are dwarfed by the natural sciences. The reason for this is undoubtedly because the applied scientists, and especially those in the department of mechanical science, have so many societies of their own that they are diverted from and lose their interest in the American Association. In engineering there are four large national societies, the civil, the mechanical, the mining, and the electrical, besides numerous local societies, aggregating a membership of probably 5,000 persons, not counting duplications of those who belong to two or more societies. The small attendance at the section of economic science is probably due to the superior attractions offered by the American Social Science Association. The recent reorganization of the American Chemical Society with its branches will be very apt to diminish the interest of chemists in section C.

These facts are worthy of consideration by those interested in the future of the Association. WILLIAM KENT.

New York, Aug. 29.

BOOK-REVIEWS.

Report of the United States Board on Geographic Names. Ex. Doc. No. 16, House of Representatives, 52d Congress. Washington, Government.

THE necessity of bringing about a uniform usage and spelling of geographic names throughout the executive departments of the government has led to the creation of a board representing the Departments of State, War, Treasury, Navy, and Post Office, the Coast and Geodetic Survey, the Geological Survey, and the Smithsonian Institution, who serve without pay and can officially say in many cases what names shall be used. Names in our country have not been bestowed by any formal authority, except the more important ones of States, counties, and municipalities. The early explorers would employ aboriginal designations or others of little import; their successors often proposed others; a mountain range would receive different names from different sides of approach. Post-offices and railroad stations may not conform to the local names of the enclosing townships, or else very familiar terms have been excessively multiplied. The modes of spelling vary from time to time. To meet the various necessities, the Board adopted the following rules in case the local usage is divided: 1, Avoidance of the possessive form of names; 2, the dropping of the final "h" in the termination "burgh;" 3, the abbreviation of "borough" is "boro;" 4, the Websterian spelling of "center;" 5, the discontinuance of hyphens in connecting parts of names; 6, the omission, whenever practicable, of the letters "C. H." (court house) after the names of county seats; 7, the simplification of names consisting of more than one word by their combination into one word; 8, the avoidance of the use of diacritic characters; 9, the dropping of the words "city" and "town" as parts of names.

As to the employment of foreign words, the Board recommend that our charts for the use of the navy adopt the local names the language of the several countries, and for home use the Anglicised forms. About 2,000 names have already been passed upon, of which a list is printed as an appendix to the report. Another appendix presents a list of all the counties in the United States.

It is easy to see that this Board is doing great service for the improvement of geographic nomenclature. Unfortunately, it cannot have power to compel the adoption of the sensible names proposed for the new States recently added to our galaxy and rejected by Congress, nor can it persuade people to use good sense after controversies have been inaugurated. The world is, however, improving, and the very objectionable names are everywhere ridiculed.

The Naturalist in La Plata. By W. H. HUDSON. London, Chapman & Hall. Ill. 396 p.

THE universal interest now taken by all classes in scientific matters has of late years given rise to a new class of books of travel. The celebrated "Voyage of a Naturalist," by Darwin, or perhaps more properly the "Wanderings in South America," by Waterton, formed the starting-point for a series which includes such books as "Travels in Peru," by von Tschudi; "Travels on the Amazon" and "Malay Archipelago," by Wallace; "Naturalist on the Amazons," by Bates; "Naturalist in Nicaragua," by Belt; "Two Years in the Jungle," by Hornaday; "Life in the East Indies," by Forbes, and many others of similar title and character. The existence and popularity of these books is evidence of the interest they have excited in the public mind; and in view of the good influence they exert there cannot be too many of them. The "Natural History of Selborne," although limited in its scope to a single parish in England, is an example of the multitude of objects which can be made interesting to all classes of readers, and it is perhaps not too much to say that there is scarcely a section of our own country about which an equally interesting book could not be written. The fact is that the objects to be studied in nature are inexhaustible. They exist in earth, in sky; in air, in water; in lane, in tree, in barren plain. Everywhere in fact that one can turn, facts of the profoundest interest are to be observed.

The ordinary globe-trotter has left few places unexplored as far as his foot alone is concerned. He has penetrated to the wilds of tropical Africa, and has left his traces amid the snow and ice of the Arctic regions; he has suffered from hunger and thirst in the deserts of Australia, and has been shipwrecked in the vast Pacific; he has explored the snowy heights of the Himalayas and the Andes, and penetrated the humid jungles of India; he has braved the sands of the desert of Gobi and the terrible glare of the Sahara. The globe-trotter used to write books describing his travels; but, alas, too frequently his eyes saw no further than his feet. He chronicled his daily aches and ills, his breakfast and supper, and mentioned the rivers he crossed or the mountains he saw. The day for such books has passed; and a man who would be listened to now must have more to tell of than how he cooked his dinner, of how many miles he sailed or walked or rode. The modern traveller must, therefore, be versed in some branch of science. He must know men, or birds, or beasts, or plants. His volume, too, must be something more than a mere itinerary; and the more closely he studies the workings of nature in her secluded haunts the wider the circle of his readers and the greater the value of his book.

Of such books as those we have mentioned above there cannot be too many. It is, therefore, with a feeling of pleasure that we welcome a late comer to the ranks, "The Naturalist in La Plata." The author is a native of the country whose phases of life he chronicles. He is an enthusiast, a lover of beasts and birds, and he makes his reader love with him. The book is filled with interesting matter, and in this notice we will mention some of the many tidbits which are offered.

One of the most interesting subjects touched upon, all too briefly be it said, is that wonderful instinct of bird migration. It seems incredible that out of twenty-five species of aquatic birds, thirteen are visitors from North America, several of them breeding in the Arctic regions and crossing the whole tropical zone to winter, or rather to summer, on the pampa. In September and even in August they begin to appear on the pampa — plover, tatler, god-

wit, curlew, "piping the wild notes, to which the Greenlander listened in June, now to the *gaucho* herdsman on the green plains of La Plata, then to the wild Indian in his remote village, and soon, further south, to the houseless *huanaco*-hunter in the gray wilderness of Patagonia." Of the godwit — *Limosa hudsonica* — some go north in March to breed; while later in the season (May) others come from the south to winter on the pampas. The north-flying birds travel thousands of miles to the hundreds traversed by those from the south. It is considered probable that these last have their breeding-places on the as yet undiscovered Antarctic continent, which they have left, after breeding, in time to winter on the pampas.

Another interesting chapter is that upon the Puma. Numerous facts are given to show that this animal, contrary to the habits of all the other wild *Felidæ*, is a friend of man, not only refraining from attacking him, but actually protecting him from the attacks of other animals, like the jaguar for example. One instance of this must suffice. During the course of an extended hunt one of the men fell from his horse, and in falling broke his leg. His companions did not notice his loss until evening, and the next morning he was found where he had fallen. He related that while lying there a puma had prowled about the vicinity but did not attempt to harm him. About midnight he heard the roar of a jaguar, and between that time and morning he several times saw the two animals engaged in fierce fights, the puma preventing the jaguar from attacking the prostrate and helpless man.

In discussing the question of fear in birds, Mr. Hudson discards the idea that it is only found in those which have been persecuted by man, and advances the theory that the older birds teach the young ones to fear their enemies. So strong is the habit of attending to the warning or danger note uttered by many birds, that when a nestling is hammering at its shell and seeking to reach the outer air, uttering meanwhile its feeble "peep," "if the warning note is uttered, even at a considerable distance, the strokes and complaining instantly cease, and the chick will then remain quiescent in the shell for a long time, or until the parent by a changed note, conveys to it an intimation that the danger is over."

Mr. Hudson is not content to record the observations he has made. He seeks also to explain, sometimes plausibly, sometimes perhaps not so well, many of the facts. For example, we are all familiar with the, to us, absurd cackling of a hen when she has laid her egg. She wants the whole world to know it. Obviously it would in a wild state be a serious objection, and be decidedly injurious to the species as a whole, to have all the egg-feeding snakes and mammals apprised of the fact that a new egg had been laid for them to seek. The author therefore contends that this habit is a perversion of the original instinct, and that while it now serves no purpose or a bad one, originally it was useful. He finds in a certain half-wild fowl of the pampa, a habit of making her nest sometimes 400 or 500 yards away from the feeding-grounds. After the egg is laid the hen flies directly from the nest 40 or 50 yards and then, still silently, runs along to the feeding-ground. Then only does she give vent to a low cackle. The cock, if within hearing, answers her, runs to her, and the cackling ceases. "If," says Mr. Hudson, "we may assume that these fowls, in their long, semi-independent existence in La Plata, have reverted to the original instincts of the wild *Gallus bankiva*, we can see here how advantageous the cackling instinct must be in enabling the hen in dense tropical jungles to rejoin the flock after laying an egg. If there are egg-eating animals in the jungle, intelligent enough to discover the meaning of such a short, subdued, cackling call, they would still be unable to find the nest by going back on the bird's scent, since she flies from the nest in the first place."

In a chapter on spiders mention is made of the many strange and wonderful features known in connection with them. Some spin a wonderfully complex and beautiful web; some live on or in the ground; many simulate inanimate objects or death itself. Of two species belonging to the same genus, one is green, while another is like a withered or dried-up leaf. The first, when disturbed, falls rapidly to the ground like a fresh green leaf broken from a twig; but the second falls slowly like a very light, dried, and withered leaf. Some of the spiders are very large and will chase a man from thirty to forty yards, keeping pace with a slow-trotting horse. An instance is related where one ran up the lash of the author's riding-whip to within three or four inches of his hand, and would have bitten him had he not thrown the whip away. Some rather fanciful speculations are indulged in when considering how a man-like monkey would act were he to have a cord permanently attached to his waist, as the spider may be considered to have his web-making material.

In an interesting chapter on music and dancing in nature, accounts are given of the habit as indulged in by many kinds of birds. Not the least strange of these is that of the spur-winged lapwing. These birds live in pairs, each pair jealously guarding its own chosen ground. But frequently one of a pair will fly off to visit a neighboring couple, leaving its mate to guard the ground. The visitor is graciously received, and the performance gone through with is described as follows: "Advancing to the visitor they place themselves behind it; then all three, keeping step, begin a rapid march, uttering resonant drumming notes in time with their movements; the notes of the pair behind being emitted in a stream like a drum-roll, while the leader utters long single notes at regular intervals. The march ceases; the leader elevates his wings and stands erect and motionless, still uttering loud notes; while the other two, with puffed-out plumage and standing exactly abreast, stoop forward and downward until the tips of their beaks touch the ground, and, sinking their rhythmical voices to a murmur, remain for some time in this posture. The performance is then over, and the visitor goes back to his own ground and mate to receive a visitor himself later on."

We have given here but a bare outline of some of the interesting chapters of the book. The one dealing with the dying-place of the *huanaco* attempts to explain the habit the animals have of returning to a remote place in which to die. It is traced back to a probable origin in ancient times when the animals herded together in winter for protection and warmth, and the idea is advanced that at present the habit is an aberrant and perverted instinct which has descended by inheritance. When the animal feels the pangs of approaching death, its feelings impel it to the spot where long ages ago its ancestors, with their fellows, found refuge and relief. Mr. Hudson thus regards the habit, not as going to a place to die, so much as going to a place to recover health. Other chapters deal with the odoriferous skunk, of which numerous anecdotes are told; with mimicry and warning colors in grasshoppers; the value and importance of the mosquito in the economy of nature and the question why it possesses a blood-sucking apparatus in such perfection, while scarcely one out of many hundreds of thousands ever tastes blood. The humming-birds are treated of in another chapter, while in still another is given a full account of a large family of birds known popularly as "wood-hewers." The biography of the *vizcacha*, the prairie-dog of the pampa, is given in full; while an account of certain birds and animals seen once or twice and then lost, never to be again brought to view, reminds one that disappointment sometimes waits upon the investigator into nature's secrets. The book is an interesting one, and we believe worthy of an extended circulation among lovers of natural objects.

JOSEPH F. JAMES.

Washington, D.C., Aug. 22.

Mineralogy. By FREDERICK H. HATCH. London, Whittaker & Co. 12°. $1.

DR. HATCH has brought together the most essential principles of mineralogy, and embodied them into what is really an abridgment of a larger treatise. He experiences the difficulty felt by earlier authors of making popular conceptions of geometrical figures and relations, and relieves it so far as is possible by stating the principles of their construction and by giving graphic representations of the perfect solids and diagrams illustrative of the crystallographic axes. There is a very wise selection of the more important figures described. Throughout the descriptions of crystalline form, chemical composition, and the various physical properties, including the choice of the minerals described, the author has shown that he knows what selection should be made in

order that the most essential features shall be presented. He is evidently a master of the whole science, and not an amateur content to explain the familiar portions and to overlook the difficult topics needful to make the sketch symmetrical. Wisdom is also shown in the classification and description of the minerals. The thoroughly scientific arrangement by chemical character, of use to the learned, is laid aside for the following practical scheme: First, the rock-forming minerals, such as are world-wide, and extend through the whole crust; second, the ores; third, the salts and useful minerals supplementary to the ores; and fourth, the gems and precious stones. Under the first head there is presented the important distinction of those that have been formed secondarily in contrast with those that were original. We think the author might wisely have devoted three or four pages, instead of a brief paragraph scarcely exceeding fifty words, to the hydro-carbons. No effort is made to describe the phenomena connected with refraction and polarization, nor to the microscopic structure, nor to petrography.

Notes and Examples in Mechanics. By IRVING P. CHURCH. New York, John Wiley & Sons, 1892.

THIS work, as stated in the preface, is "a companion volume to the writer's 'Mechanics of Engineering,' and contains various notes and many practical examples, both algebraic and numerical, serving to illustrate more fully the application of fundamental principles in mechanics of solids; together with a few paragraphs relating to the mechanics of materials, and an appendix on the "Graphical Statics of Mechanism." A knowledge of the elements of trigonometry and calculus is assumed.

The work is clear and practical. Many problems are first treated analytically, then by assuming numerical values for the several algebraic quantities. English units are used. Engineering data are drawn from well-known and reliable authorities.

Among the structures and machines discussed (after the necessary exposition of general principles) are the bell crank, simple and compound cranes, wedge, roof truss, pendulum, weighted piston with steam, I-beam, box-beam, fly-wheel, locomotive, jack-screw, ore-crusher, etc.

The work is abundantly illustrated with cuts.

Light. By SIR H. TRUEMAN WOOD. London, Whittaker & Co., 1891.

THIS elementary Treatise belongs to Whittaker's "Library of Popular Science." The undulatory theory is presented in clear and non-mathematical language, and the various phenomena of common observation are explained on this theory.

In a very lucid and attractive style, the author discusses such topics as reflection, refraction, color, optical instruments, the chemical action of light (as in photography), polarization, and fluorescence. The cuts are abundant and well drawn.

The appendix contains an annotated list of elementary works on light, color, spectroscope, etc.

Chemical Calculations, with Explanatory Notes, Problems, and Answers. By R. LLOYD WHITELEY. London and New York, Longmans, Green & Co. 1892.

A WIDE range of topics is included in these hundred pages: as metric system, thermometric scales, density and specific gravity, percentage composition of compounds, calculation of empirical formulæ, volume of gases, calculations depending on chemical equations, combination of gases by volume, calculation of the results of quantitative analysis, atomic weight determinations, gas analysis, absorption of gases by liquids, molecular weights, calorific power and calorific intensity.

The problems on molecular weights are not confined to vapor densities; but the more recent methods of freezing points (Raoult) and boiling points (Beckmann and Wiley) are duly explained.

The table of atomic weights is based upon $O = 16$, and agrees, for the most part, with Ostwald's "Outlines of General Chemistry;" thus $H = 1.003$, in accordance with the older determina-

Publications Received at Editor's Office.

DAY, DAVID T. Mineral Resources of the United States. Washington, Government. 8°. 678 p.

GARNER, R. L. The Speech of Monkeys. New York, Charles L. Webster & Co. 8°. 233 p.

JACKMAN, WILBUR S. Nature Study for the Common Schools. New York, Henry Holt & Co. 12°. 448 p.

MERRILL, GEORGE P. The Materials of the Earth's Crust. Washington, Government. 8°. Paper. 87 p.

SALTER, WILLIAM M. First Steps in Philosophy. Chicago, Charles H. Kerr & Co. 12°. 155 p. $1.

U. S. DEPARTMENT OF AGRICULTURE. Insect Life. Washington, Government. 8°. Paper. 90 p.

"WATERDALE." Researches on the Dynamic Action and Ponderosity of Matter. London, Chapman & Hall. 12°. 309 p.

WATKINS, J. E. The Log of the Savannah. Washington, Government. 8°. Paper. 30 p.

WELLS, CHARLES R. Manual of the Natural Movement Method in Writing. Syracuse, C. W. Bardeen. Sm. 4°. Paper. 44 p. 25 cts.

WILLIAMS, SAMUEL G. The History of Modern Education. Syracuse, C. W. Bardeen. 12°. 403 p. $1.50.

tions of the ratio O : H. For many of the problems, however, the atomic weights are rounded to whole numbers, except Cl = 35.5.

The work is recommended as a well-planned text-book of the subjects indicated.

Mechanics for Beginners. Part I. Dynamics and Statics. By J. B. LOCK. London and New York, Macmillan & Co., 1891.

THIS is a carefully-prepared elementary text-book, presenting the subject in the following order: rectilinear motion, motion in one plane, forces acting at a point, parallel forces, machines (including friction), uniform motion in a circle, energy, the pendulum. The definitions are clear and examples abundant. The demonstrations presuppose a knowledge of trigonometry.

English units are employed throughout. The following terms are convenient (in the absence of metric units), but not very familiar in this country: *velo*, the velocity of one foot per second; *celo*, the acceleration of one *velo* per second; *poundal*, a force producing one *celo* on one pound; and *foot-poundal*, the work done by one *poundal* acting one foot.

While this work shows marks of thoroughness, it seems a great pity to ignore the international system of weights and measures.

Elementary Lessons in Heat. By S. E. TILLMAN Revised Edition. New York, John Wiley & Sons, 1892.

THESE lessons, prepared as a short course for the U. S. Military Academy, present the most essential and practical aspects of the subject, in a clear and descriptive manner. The language of trigonometry and differential calculus are scarcely introduced, even in discussing the conduction of heat. English units are employed, for the most part. The various kinds of thermometers and other instruments required by observers are explained; and the last two chapters are devoted to meteorology.

Forty-six numerical problems are added in this edition, illustrating thermometric scales, linear and cubic expansion, properties of gases, specific heat, latent heat, relative humidity, and mechanical equivalent of heat.

AMONG THE PUBLISHERS.

THE September number of *The Mother's Nursery Guide* contains medical articles on "Natural and Artificial Feeding of Infants," "A Short Talk about Disease Germs," "Some Common Nervous Diseases," etc. Other subjects are: "A Mother's Duty in Mental Child-Training," "Kindergarten-at-Home Stories," "A Child's Vocabulary," etc.

— All teachers and those interested in the eduction of young children will wish to read the article in *The Atlantic Monthly* for September by Horace E. Scudder, entitled "The Primer and Literature." This paper proves in a very logical, clear, and interesting manner that "the time has come when the . . . statement may be made that there should be no break in the continuity of literature in the schools; that from the day when the child begins to hold a book in his hands until the day when he leaves the public school he shall steadily and uninterruptedly be presented with genuine literature; that the primer itself shall serve as an introduction to literature." The paper will well repay careful reading and discussion.

many sources being all thought fit to yield their share of the ice harvest.

Fortunately of late years, owing to the repeated failure of the ice-crop, the larger cities in the east are mainly supplied with "artificial" ice. This ice, being formed as it is in the greater number of cases from the regular water-supply of the city, ceases to a large degree to be a source of danger from organic contamination. There have been cases, however, and notably one which fell under my own observation, where an ice company, advertising their ice as made only from pure distilled water, produced daily for some weeks beautiful cakes of crystalline ice, the centre of each cake a rich, dark-brown, and actually giving forth an offensive odor! Some of these samples were sent to me for analysis, and the results were most startling, indicating rather a concentration of impurity, both organic and inorganic, than a distillation or purification. The cause was naturally looked for and found in the stills themselves, which were eventually overhauled and remodeled, with the result that finally a first-class high-grade ice was put on the market.

The necessity for an absolutely wholesome water-supply for the manufacture of ice is at once apparent, as in processes generally in use the entire contents of the water tanks are frozen, and all impurities contained in the water must needs enter the ice. The case referred to was interesting, showing as it did how the color and organic matter had been concentrated in the middle of each cake. The ice forming first at the sides had repelled these impurities until finally, with the freezing of the entire mass, they had of necessity been included.

ELEMENTARY SCIENCE IN THE PUBLIC SCHOOLS.

BY HENRY MONTGOMERY, PROFESSOR OF MINERALOGY AND GEOLOGY IN THE UNIVERSITY OF UTAH, SALT LAKE CITY.

MANY years' continuous service as a teacher of young men and women, in a measure, unfits one for acting as an instructor of children. I do not say that a teacher of children requires greater or higher qualifications than a teacher of college students; but the qualifications must be different. One who aspires to be a teacher and leader of students of advanced subjects as taught in colleges and universities ought to have good mental faculties and these ought to be in a high state of cultivation. With the increasing intricacy and complexity of the studies come increasing difficulties for the students. These difficulties must be recognized and dealt with by the instructor. Hence the successful university teacher must be possessed of teaching powers suited to the minds of students of the advanced branches in which he undertakes instruction. Both the character of the studies and the mental condition of the students of the university differ widely from those of the pupils of the common school. Consequently the teachers of these two classes of pupils must differ widely as to qualifications. Between the primary or common school, on the one hand, and the university, on the other, comes the secondary or high school, which, of necessity, must be supplied with teachers of somewhat different qualifications. The high-school teachers must be adapted to the work of instructing pupils of certain attainments and generally of a certain average age, which stand between the common school and the university. A still more satisfactory grading is effected by classifying all pupils in five divisions, viz., the kindergarten, the common school, the high school, the college, and the university; and in these, especially in the common school, a further grading often proves beneficial. It has many times been found that one who has succeeded well teaching a class in some branch in the common school, has not succeeded as a teacher of a lower class or a higher class in the same branch and in the same school. We all know that a child will voluntarily leave other children that may be older or younger than himself, and seek out those of his own age, or, rather, of his own mental attainments; and, again, on reading a story to a child of nine years no interest is awakened, while on reading the same to another two or three years older or younger the most lively interest and appreciation of it are immediately manifested. The first thing, then, to be considered in the teaching of science is the stage of the development of the faculties of the child. Let this be first diagnosed, and then let no mistake be made in prescribing the kind of material suited to his condition, and the character of the methods of instruction to be employed in his particular case.

To the question, Should science be taught in the public or common schools? I answer in the affirmative. Most decidedly, yes. Which of the sciences? Should it be chemistry, or physics, or zoölogy, or mineralogy, or botany, or physiology, or geology? I answer, all of them as one subject, the study of nature. Specialization, differentiation, or the division of labor, characterizes civilization. It is forced upon us in the higher studies. This is simply a matter of necessity, due to the vastness of the fields of higher learning, the shortness of life, and the limits of the human mind. But, it is possible to specialize only in the maturity of manhood and womanhood. It is not possible in childhood. The youthful mind is not capable of such work. The young mind is not able to fix attention or concentrate thought upon a subject, and particularly if the subject be studied in an isolated and disconnected manner. Add to this a method that is both systematic and abstract and the avenues to learning are completely closed. In very early years, say before the age of eleven or twelve, the average child cannot readily or profitably study anything in an isolated, a systematic, and an abstract manner, and he can do it but very feebly at this age. The study of a subject systematically by classification, the study of the abstract, and the cultivation of the reasoning faculty should not be attempted early. Nature rebels against it. It is the faculty of perception which appears first. This is the faculty which should receive the attention of the teacher of children. To the cultivation of observation, expression, and memory, along with the full physical development of the child, all the best energies of the teacher should be given. It is not a question, then, of dividing and classifying the natural and physical sciences, and choosing one or more of them to be placed on the curriculum of schools. This is necessary and proper in the later years of the high-school courses, and in the higher institutions, but not in the common school, or to any great extent in the lower classes of the high school. System, method, and classification in study are exceedingly important for matured persons; but, they do not belong to early life. As soon as the mind is prepared to undertake such work, it should be begun; and it should be increased very slowly, gradually, and almost imperceptibly. I repeat it, common-school pupils ought not to be taught zoölogy as a distinct science, nor botany, nor physics, nor geology as such. All systems of classification, even to the division of these sciences, are artificial. Chemistry, physics, mineralogy, botany, zoölogy, physiology, and geology should not be separated. These sciences come naturally together; and, therefore, they are most readily understood and remembered when studied in this way. Let the child see the fish swim in the water, the bird fly through the air, the duck swim and sail on the pond, the river erode its banks, the waves beat and grind the pebbles against one another on the beach. Let him be led to use his senses in observing the soil, clay, sand, gravel, grasses, trees, flowers, butterflies, beetles, worms, crops, streams, hills, ravines, bees, squirrels, ants, crickets, birds, snow, rain, stones, rocks, and fossils, just as they occur in nature. In any case, even to adult persons, the associations are of vital significance. Many a time it happens that a mineral sample, a bit of rock, or a fossil, by itself is of but little use in helping us to understand some question of moment. Again, an extract from a book may be unintelligible or ambiguous. But, in the one instance, permit us to see the associated minerals and rocks in position, and, in the other, to read the context, and what a flood of light is let in upon us! The relations that objects of the three kingdoms of nature bear towards one another are of the utmost importance. But, in addition to the importance of the associations and relations, the ease with which children are enabled to comprehend the characteristic structure, habits, and uses of anything when studied as it occurs in nature, is something the teacher and parent cannot afford to ignore. An old-fashioned method of teaching orthography consisted in compelling the pupil to learn a column or a page of isolated words chosen with reference to the number of syllables they contained. Some of these words were extremely rare; many of them would not be

condens ... water stan ... much higher, an ... great care in order t... where the ice may be m...
In regard to the preparatio... Nichols, in his admirable work or

... Guebres, followers ... th century, for the ... seen to the present ... 20 kilometers from ... winds, at an eleva- ... Caspian Sea. The ... kilometers. At the ... more than 1,000 ... twenty-four hours ... d in the history of ... , which started at ... rased a small busi ... n on a small scale. ... aku was effected ... bel endeavored to ... transport, and rec- ... it the majority of ... constructed the ... tility of it to his ... his example, and ... which cost more ... ied with the sys- ... the Kavkaz and ... the Volga that ... conveyance of ... d, the firm con- ... pense. This in- ... et thought, was ... tries, and tank- ... ing, are to be ... It is also to M. ... h contain hun- ... They are to be ... verywhere else ... of innovations ... improve land- ... way Company ... ansport of the ... d years. The ... y the expendi- ... t constructed ... immediately ... e wagons cir- ... ine.

... the Michigan ... University of ... ell, professor ... arpless, pro- ... of civil and ... g have been ... ructors, and ... on has been ... ; Dr. Alfred ... ese two have ... h the Mining ... duat- of Cor- ...

... ve ... enti ... Aman

... he Messrs. ... Nature and ... leasures of

be obliged, four or six hours a day, to teach, as best they can, perhaps without maps, globes, charts, models, pictures, or any other appliances of a proper sort. This would be somewhat bearable, aye, even profitable, were the pupils sixteen to twenty years old. But it is a terrible thing for children, and a terrible thing for their teacher, to be expected to endure. Such teachers and children have my sympathy. I sincerely pity them. Think of trying to hold in quietness and attention in a schoolroom, for hours at a time, forty or fifty children, whose tender, growing bodies and minds call loudly for air, for sunshine, for exercise and freedom! What is the use of talking about teaching science so long as in our very attempts to teach it we continue to act in opposition to the laws of nature? A striking example of this inconsistency occurred some years ago in a well-known eastern university. While the professor was lecturing on hygiene, one of his students fainted for want of pure air, the room being closed up and utterly destitute of ventilation. With the view of enlarging and improving the facilities for elementary science instruction, permanent collections might be made in every school. But really good collections, kept in proper order, cost a great deal, and, consequently, must be few in number. Good museums in cities might be made highly useful to all the common-school children within easy reach of them. They would be a relief to all in winter, and they would at all times be useful to those whose school buildings might chance to be situated near the centre of a large city and at an inconvenient distance from the fields and hills of the open country. Especially should we expect the State university museum to be made convenient, attractive, and instructive to all grades of young and old students. All parts of our public educational system should be consistent and in harmony. If a university can be equipped in such a manner that visits to its museum and inspections of its collections may be a source of pleasure and instruction to the pupils of the public schools of the State, or even any considerable part of the State, it will surely be so much the better. Well-arranged, well-labelled, and well-lighted university museums may and should serve as great educators of common-school pupils, as well as of the general public, who may visit them from time to time. In California, and at least one or two other States, the express companies carry specimens for the State universities free of charge. In New York State and some other places, the students in training at the State normal schools are required to pay only half the railroad fare to and from these schools, although many of them travel several hundred miles to reach them. A number of the eastern and northern States have for some time been furnishing free text-books for the public schools; and, in Ohio, not only are free text-books provided for the school children, but the State legislature has also taken measures for the supply of clothing for the pupils where it may be necessary. Now, as before stated, museums of any great value or importance must be few. They are too expensive to be numerous in an ordinary State. They cannot be transported from town to town. Why should not some arrangement be effected by which pupils of school age, and in regular attendance and full standing in the schools, and their teachers might receive free railway transportation at least once a year to and from the State university museum? Knowing what is done for public schools by a few large museums, I am of opinion that greater efforts should be made in this direction in all the States, and also that strong efforts should be made to better the university collections, keeping in mind the necessities of the public schools.

Were I asked for other advice regarding methods of teaching elementary science, I would say, that the pupils should be started with the study of the familiar, that which is most readily observed and best known. The subject matter should consist of common things, and the language of the teacher should be simple and intelligible to the pupil. Some twelve or fifteen years ago the distinguished scientist, Professor Huxley, published a book on practical biology, in which he adopted and advocated the system of study by which the student begins with the lowest and simplest forms of life and proceeds to the higher and more complex organisms. Owing to the fact that the lowest living beings are microscopic and obscure, this was altogether unnatural and unscientific. Yet, because Huxley adopted it, almost every teacher of biology, in English-speaking countries, adopted it too. Within a few years it became evident that (except with advanced and well-trained students) the results were far from satisfactory; and, accordingly, in the preface of a later edition of the book, Professor Huxley writes that experience has shown that the order ought to be reversed, and that henceforth the student should begin with those forms of life which are somewhat familiar, and proceed to those less known.

In the next place, I would warn the primary teacher against teaching the details of any subject to very young children. Unwise choice of material, and the forcing of a heap of details upon children, correspond closely to the old system of teaching spelling by selecting long and very rare words. This far-fetched material should never be used in primary teaching. Only the more conspicuous and general characters, uses, etc., should be dwelt upon, unless, in very exceptional cases, where, for some good reason, the child may appear to be profited by a minute account of any animal, plant, or mineral. In all cases, the details are most out of place when there is no object of the kind present. As far as possible, the teacher should keep close to the wishes and inclinations of the child in the choice of subject matter, and work along these lines, so long as there seems no good objection to his wishes. With high-school pupils, I would recommend the frequent use of the microscope. In the hands of an intelligent teacher, this instrument may be used to advantage with small classes of pupils, say, above thirteen years of age. A stereopticon or projecting lantern should often be used in all grades of schools. Certainly for a high school, no better investment can be made, and the common schools of any city might, by arrangement with the high-school teacher, who operated the lantern, become recipients of the benefits to be derived from the possession of this piece of apparatus.

A word or two with regard to physiology and hygiene. I consider that the teaching in these subjects should be greatly improved. I would not have a great amount taught; but, in several respects, it needs to be made more practical. Time will not allow me to expatiate upon these matters here. Yet I cannot refrain from directing attention to the fact that, for reasons of delicacy, three systems of organs of the human body, either partially or entirely, are invariably omitted from the course of instruction in all of our schools. For both moral and sanitary reasons, I am inclined to think something should be done, and that something will yet be done to provide for a wholesome, intelligent, and practical course in these subjects. It may be that at present little can be done; but I venture to suggest that where it is altogether practicable to do so, perhaps in some city high schools, the sexes receive instruction in these studies in separate class-rooms, and from capable and proper instructors. It would, of course, be absolutely essential that the instructors have properly constituted minds, and be especially qualified to speak to and deal with young persons, in order that good might come of their instruction. This is undoubtedly a difficult problem to solve. It must, however, be admitted that it is a very important one.

Again, the science teacher must have interest in the studies themselves. I have not much faith in the common, little, artificial devices for exciting the interest of the pupil. They are but the nostrums of quack doctors. They remind one of the application of ointment or salve to the external surface of the body to cure a disease which has its seat in impure blood or in a weak nervous system. They are not born of sympathy or interest in the study. The teacher should be interested in the studies as well as in the pupils. It is all right to desire to do good to the children, but there must in addition be a pleasurable enjoyment felt by the teacher in the prosecution of the study itself. In fact, interest in the study — a spirit of inquiry, of enthusiasm, if you will — is of the utmost importance. Teachers and pupils alike need it. Teaching must not be done merely for money; it must not be done in order to show one's knowledge. The pupil must not ask questions with the view of puzzling the teacher, or of showing his own learning or smartness. Too often do we get students who have been so praised and flattered by their previous teachers, that it is exceedingly difficult and sometimes impossible ever to do

anything for them. They are keenly disappointed at not being acknowledged as perfect in their studies, and are ever anxious to show their learning. It takes a long time to work them down to their proper level. Teacher and pupil should ever seek truth. They must come to their work in a spirit of earnestness, absolute honesty, candor, and sincerity, otherwise the work will be a failure. The really true teacher is an inspired man. He draws the pupils around him, because he is himself interested in his studies. Such were the great teachers of old, and if any of us now succeed in any measure as teachers, it is only so far as we possess interest and enthusiasm in our studies.

Frederic Harrison, with forty years' active experience in educational work, in writing of late, said: "I have for years past joined in the discussions and conferences on this question; and now I feel at times that we are further off the right path than ever, as if our whole system were a failure. There are hours when I feel about education nothing but this, — wipe it out, and let us begin it all afresh." This was written a few months ago with reference to education in England; but it was in relation to some of the very matters that are engaging our attention in this country at the present time. I cannot go so far as Harrison does in this expression of his opinion. I know the public schools of this country have done and are doing a useful and a noble work. The nation cannot do without them, nor can it afford to permit their usefulness to be impaired through lack of support and sympathy. Give them the support and encouragement they need and deserve, and they will be improved, and the country profited thereby. Honest and intelligent interest in the schools should lead to improvements in their condition. If changes in the system seem desirable, let them be made. Let neither prejudice nor individual selfishness stand in the way. It has more than once been stated by American educators of experience and high standing that science-teaching is difficult, and that there are few, very few, teachers capable of engaging in it. I fear there is much truth in this statement. Science, like any other subject of education, must be taught by a competent person. It is folly to expect proper results from persons who have not both the natural and the acquired qualifications of a true teacher, and it is much greater folly to expect them from those who have neither of these two qualifications. Teachers possessed of both are indeed rare; and how can we expect them to be plentiful so long as the trustees and boards of education, and the people behind the trustees and boards, remain satisfied with so low a standard? When the public come to realize that a higher standard of qualifications, mental and moral, on the part of the teacher, is absolutely necessary for the welfare of our country, when they come to have a heartier appreciation of high-class attainments, they will be willing to make adequate compensation for the teacher's labors and influence, they will seek teachers of longer and better training and experience, teachers who carry with them an atmosphere of a higher and a more inspiring character. I have hope that this time will come. Let us do what we can to bring about these conditions. For the sake of the youth of our land, for the sake of the material, the physical, the moral, and the intellectual advancement of our country, for the sake of everything that can contribute towards the promotion of the civilization of this great nation, let us earnestly pray that the dawn of that day may be hastened, that the free public-school system, which forms a net-work throughout the length and breadth of this Union, may, more truly and fully than ever in the past, yield those practical and beneficent results anticipated by its founders, hoped for by its friends, and rendered necessary by the foundation principles of the government of a free people.

NOTES AND NEWS.

A REPORT on the petroleum trade of the Caucasus has been sent to the Turkish Government by Aassib, the Turkish Consul-General at Tiflis, and some interesting extracts from it are quoted in the *British Board of Trade Journal*. The petroleum springs of the peninsula of Apsheron, not far from the place at present occupied by the town of Baku, were known, according to the writer, several centuries before the Christian era, and the phenomena produced by them, totally inexplicable in those barbaric ages, gave rise, he says, to the worship of the Guebres, followers of Zoroaster, which lasted into the nineteenth century, for the temple of the worshippers of eternal fire is seen to the present day. The springs of Balakhani are situated 20 kilometers from Baku on a bare and arid plateau, swept by the winds, at an elevation of about 60 meters above the level of the Caspian Sea. The petroleum lands occupy an area of about 8 kilometers. At the present time Balakhani and Sabountchi possess more than 1.000 wells, some of them newly bored, producing in twenty-four hours as much as 400,000 pouds. An era was marked in the history of the naphtha industry by the house of M. Nobel, which started at Baku in 1874, and in the following year purchased a small business and undertook the production of petroleum on a small scale. At that time the conveyance of petroleum to Baku was effected by means of carts and leather bottles. M. Nobel endeavored to show the absurdity of this primitive method of transport, and recommended that pipes should be constructed, but the majority of the merchants rejected the proposal. He then constructed the first pipe at his own cost, and demonstrated the utility of it to his colleagues, several of whom very soon imitated his example, and Baku has to-day a dozen lines of pipes, each of which cost more than 100,000 roubles. The same house, dissatisfied with the system of shipping petroleum in barrels, proposed to the Kavkaz and Mercury Navigation Company of the Caspian and the Volga that they should build tank-boats for the exclusive conveyance of petroleum. This proposal having been rejected, the firm constructed several of these vessels at their own expense. This innovation, of which even the Americans had not yet thought, was accepted by the two petroleum-producing countries, and tank-boats, the number of which is constantly increasing, are to be found on all the waters of the civilized world. It is also to M. Nobel that those gigantic reservoirs of iron which contain hundreds of thousands of naptha products are due. They are to be seen in large numbers at Baku, Batoum, and everywhere else where petroleum is carried in bulk. The series of innovations by M. Nobel do not stop there. With a desire to improve land-carriage he proposed to the Griazi-Tsaritsine Railway Company the construction of special tank-wagons for the transport of the petroleum, guaranteeing a load for them for several years. The railway authorities scoffed at the idea, and it was by the expenditure of very large sums that the Swedish merchant constructed for his own use the first tank-wagons. Scorn was immediately changed to enthusiasm, and to-day thousands of these wagons circulate on the railways of Caucasia and Griazi-Tsaritsine.

— The following appointments have been made at the Michgan Mining School: Dr. George A. König, late of the University of Pennsylvania, professor of chemistry; Edgar Kidwell, professor of mechanical and electrical engineering; Fred F. Sharpless, professor of metallurgy; Fred W. Denton, professor of civil and mining engineering. All these except Professor König have been connected with this school for several years as instructors, and have earned their promotion. Dr. Horace B. Patton has been appointed instructor in mineralogy and petrography; Dr. Alfred C. Lane, instructor in petrography and geology. These two have been connected both with the State Survey and with the Mining School for several years. Mr. Carroll L. Hoyt, a graduate of Cornell University in the mechanical engineering department, has been appointed instructor in drawing and mechanical engineering.

— A cuneiform tablet has been found at Tel Hesy, the ancient Lachish, by Mr. J. F. Bliss, who is excavating for the Palestine Exploration Fund. According to Professor A. H. Sayce of Oxford it contains the name of the same officer who is mentioned on tablets from Lachish, found some years since at El Amarna in Egypt.

— Sir John Lubbock will shortly issue, through the Messrs. Macmillan & Co., a work entitled "The Beauties of Nature and the Wonders of the World," uniform with his "Pleasures of Life."

— Messrs. Macmillan & Co. have in press, to be issued very shortly under American copyright, a long-expected "History of Early English Literature," by Rev. Stopford A. Brooke.

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THE AMERICAN ASSOCIATION AT ROCHESTER.

BY D. S MARTIN.

THE recent meeting of the American Association for the Advancement of Science was in all respects a pleasant and successful one. The beauty of the city of Rochester, the absolutely perfect weather that lasted through the entire session, and the careful and systematic arrangements of the local committee all combined to favor the attending members. The number present was in all 455, larger than at any meeting in the past ten years, save the exceptional ones at Philadelphia, New York, and Washington, and ranking seventh in the entire series of forty-one meetings.

The sessions were held in the University of Rochester, whose handsome and commodious buildings are surrounded by a large and very beautiful campus. This latter was a constant source of enjoyment, like the university grounds at Toronto in 1889, where the midday interval could be passed under noble trees and on velvety grass, with the lake breezes to refresh the air. No pleasanter "environment" has ever been enjoyed than at Rochester; while the fine collections of the university in Sibley Hall and the proximity of the celebrated "Ward's Natural History Establishment" and the Warner Observatory gave added scientific interest.

A large number of local geological trips were made to points of interest in the neighborhood. Among these may be mentioned the great gorge of the Genesee and the Lower Falls, where the Clinton and Niagara rocks are so grandly exposed in section; the glacial deposits of the Pinnacle Hills, south of the city, which present some problematical features; and last, but not least, the rock-salt mines at Leroy and Livonia, some twenty to thirty miles southward of Rochester, where the great deposits of solid salt are reached at 1,010 and 1,369 feet of depth, respectively, and immense works are in process of construction. The age of these beds, as is well known, is salina, or perhaps more strictly waterlime.

The regular Saturday excursions arranged by the local committee had also much of a geological character, some going to Niagara, others to the Portage Gorge of the upper Genesee, and others to Stony Brook Glen, all of these being magnificent examples of stream-erosion.

Another matter of local interest was the opening to the members, by courtesy of the family, of the mansion and library of the late Hon. Lewis H. Morgan, president of the association in 1880 and eminent as a writer and student in archæology and ethnology. The visit to his library and collection was an occasion of gratification to many.

To specify or enlarge upon particular papers among the many and valuable ones presented, would be difficult and perhaps invidious. It is, however, but fair to say that especial interest, in sections E (geology) and H (anthropology), was developed in the active discussions that arose regarding two subjects — that of Comparative Geological Chronology as presented by Professor W. J. McGee, and Aboriginal Quarries of Flakable Stone by Mr. W. H. Holmes — both of Washington. Professor McGee's general doctrine is that, using erosion as a measure of time, it is possible to fix somewhat definitely the relative lengths of certain recent geological epochs, and then (as generally admitted on the basis of sedimentation, as by Dana and others) of the older and greater periods. Then, by fixing a date in years for the last glacial epoch, it becomes possible to estimate somewhat the duration of geological time. This last date, based partly on Croll's astronomical theory and partly on various strictly geological data, he would place at about 7,100 years ago. Using this as a unit of estimate, the relative time indicated by erosion, etc., to the "Columbian" deposits, is to this date as 30 ± to 1, giving about 200,000 years to the Columbian (early Quaternary); while the same process will require some fifty times as much, or 10,000,000 years, to the "Lafayette," late Tertiary. It is easy to see from these figures, when compared with the time-ratios for the geological ages as given, e. g., by Dana, how stupendous a time is demanded by Professor McGee's view, and how extreme is the difference between the geological requirements on the one hand and the duration allowed by the physicists and astronomers on the other. The discussion that arose was naturally active, and the subject is one likely to be prominent for some time to come.

Mr. Holmes has been investigating aboriginal quarries extensively, and presents the view that immense quantities of merely unfinished and rejected material at these points exhibit all the characters of so-called "palæolithic" work. He therefore questions strongly the palæolithic age of much that has been so regarded, certainly in this country. The discussion of this and other papers in the section showed a strong tendency to demand more proof, and that strictly stratigraphical, than has often been given in describing "palæolithic" implements and drawing inferences therefrom. Those who accompanied Mr. Holmes a year ago to his aboriginal quarry in the Potomac gravels at Piney Branch, near Washington, will remember that visit with increased interest in view of this important discussion.

Much else might well be mentioned, but space forbids. As a whole, it may be said that few meetings of the association have been more agreeable or more profitable than the one just closed at Rochester.

The decision to hold the next session at Madison, Wis., rather than at Chicago, is generally approved. The place is near enough to give the members opportunity to visit the World's Fair before or after the association meeting, and far enough away to escape the crowd and the distraction; while the provision made for a permanent headquarters for each section of the association during the entire period of the Fair, in rooms set apart for that purpose, is a most happy and desirable arrangement for the comfort and convenience of members visiting Chicago.

AMERICAN BOTANISTS AND NOMENCLATURE.

BY JOHN M. COULTER, PRESIDENT OF INDIANA UNIVERSITY.

THE Rochester meeting of the American Association was a notable one for American botanists. They had so burdened section F with papers in the years that are past that nothing was left but to organize them into a separate section, under the letter left vacant by the deceased Section of Microscopy. This calls for congratulation as testifying to the growing numbers and activity of botanists. Among botanists, however, the meeting was still more notable from the remarkable merging of all differences of opinion into an agreement concerning nomenclature.

This subject has not only brought botanists into conflict with each other, but into disrepute with fellow-scientists. Force seemed to be wasted in upholding varying personal opinions. So far as American botany was concerned, there seemed to be two hostile camps with

reference to nomenclature. How much of genuine good-feeling and exchange of courtesies existed under cover of this public hostility is known only to the botanists themselves. Every one desired a stable nomenclature, but the conservatives held so doggedly to the old, and the radicals ran so persistently to the new, that the result was chaos. It was speedily found that "good usage," which was founded upon individual opinion, could never bring stability in face of the fact that scores of botanists felt equally competent to stand for "good usage."

The culminatian of all these upheavals came in the famous book of Otto Kuntze, which looked like the end of all things to conservatives, and even made the radicals stand aghast. Kuntze wrought better than he knew, and has undoubtedly been largely instrumental in inducing a common movement among European and American botanists to attempt to secure some basis of agreement. His book will probablé stand as a good example of what-not to-do in matters of nomenclature. The International Congress of Botanists at Genoa (Sept. 4–11) was a favorable opportunity for presenting the matter, and hence the almost simultaneous appearance of papers from Berlin and New York and Washington for signatures.

At the meeting of the American Association at Rochester (Aug. 17–24) an unusually large number of botanists who deal with nomenclature were present, and they had with them (by letter) the opinions of nearly all who were absent. Not only was the representation very large, but the willingness to concede for the sake of agreement was remarkable, no such fraternal feeling being anticipated by the most sanguine. The discussions were full, free, and informal; every shade of opinion being presented and carefully considered. The principles that were finally adopted were not numerous, and additions will undoubtedly be necessary, but they were adopted with wonderful unanimity, and must commend themselves to anyone who studies them and who understands the forces that were at work in formulating them. Probably not a single individual opinion is fully expressed by these principles, but that resultant of opinions, which must be a far more influential thing.

The selection of 1753, the date of the first edition of Linnæus's "Species Plantarum," as the common point of departure for genera and species, seemed to be conceded almost without debate. This is no place to discuss the many very important considerations which urge the selection of this date; but it will certainly bring a feeling of stability in generic names that no other selection could have brought. It at once remands to silence all that region of uncertainty which necessarily lies beyond the time when species definitely stood as representing genera.

The fixity of the specific name has long been recognized as a working principle, and the only objection has been to making it an *ex post facto* law. But this would at once make two points of departure, and the changes are not so numerous after all.

The homonym section is also a wise one, as chiefly becomes apparent to those who have been compelled to reinstate an old group and so turn adrift and nameless some other group that may hold no relation to it.

It is probable that the section defining what is meant by the publication of a species will be the only one that will meet with criticism. To most of the botanists at Rochester, however, the definition strongly commended itself. The criticism will not be directed at what the definition contains, but at the fact that it omits the distribution of named specimens. This omission, however, can only touch chiefly comparatively recent distributions, for the names of the older classical ones have surely long since been protected by some form of publication which comes under the provisions of the section. The mixture of material under a single number in large distributions is not only well known, but probably to be expected, especially among plants in which the characters are microscopic. Herbarium names are also a great bar to the study of systematic botany, now that it has become a democratic thing, and a provision which compels all specific characterization to be widely accessible is a reasonable one.

It is to be expected that all American botanists will gladly use these principles, as it will remove a feeling of uneasiness in their work, a feeling which has sometimes compelled some of them to make sure of their species by mentioning the names they would bear under the different systems of nomenclature.

Names are things of secondary importance, and the long discussion of non essentials has seemed wearisome to many, but disputes are usually about non-essentials, are always wasteful of energy, and should always be adjusted.

CURRENT NOTES ON ANTHROPOLOGY.—XIV.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The Selection of Comparative Vocabularies.

THE student whose investigations lead him to the comparison of languages and dialects is constantly impeded by the absence of any uniform schedule of words employed by travellers in securing specimens of them. This is one of the many points on which it would be most desirable that some international agreement could be reached.

The colonial department of the German government has recently published a schedule of about 800 words, which will be adopted by its officers and explorers. The list has been prepared by the eminent linguist, Professor Georg von der Gabelentz, and is published by Mitler & Son, Berlin, under the title "Handbuch zur Aufnahme Fremder Sprachen." It is prefaced by a series of practical observations and directions which will prove of much utility to the collector.

Our government has also an official schedule of words published through the Smithsonian Institution. It is a monument of colossal misconception of purpose and theory-hunting. The terms for kinship alone number 1476, and contain such as the following: "My mother's elder sister's daughter's daughter's daughter's husband!" Instead of being a convenient octavo, which one can slip in his pocket, as is the German, it is a bulky quarto of 250 pages, much of it taken up with quite useless matter. I venture the assertion with confidence that no collector has ever filled up its blanks.

Primitive Man in South America.

The doubts expressed in these "Notes" as to the age of some of the recent discoveries of anthropoid remains in South America (see *Science*, March 11) have been echoed with force by M. E. Trouessart in an article in *L'Anthropologie* for June. The hypothesis of a miocene man in the area of the Argentine Republic or Patagonia, advanced by Ameghino and others, has received a rude shock through the researches of Professor C. Steinmann of Freiburg. According to him, the Pampean formation corresponds to the Loess of North America, and is inter-glacial in date, and not pliocene, as Doering and Ameghino teach; and their alleged miocene is merely a part of the great deposit of the Austral glaciation. This he believes occurred at the same time as the ice age of the northern continent.

This opinion seems to be borne out by a comparison of the fauna of the oligocene of Patagonia with that of the alleged miocene of La Plata. The differences are quite too great for them to belong so near together. Twenty per cent of the Pampean forms are still living species in the same locality, which would be enough to cast grave doubts on its high antiquity. Here, therefore, as in so many other spots on the American continent, the vast antiquity of the remains of man is materially diminished by closer scrutiny.

Race and Culture.

A recent pamphlet by Professor Frank W. Blackmar, of the University of Kansas, on Indian education, brings up the general subject of the attitude of the lower races toward the culture of the highest. This sociological study, carefully prepared from authentic statistics, substantially acknowledges that while in individual instances there is no intellectual inferiority in the Red Race, its members are unable to face the light of civilization and live. Even when educated they must be protected, especially against their own people, but also against the whites. His final words are :—

"The Indian must be drilled, trained, and placed in an occupation which offers protection on the one hand and restraint on

the other. Otherwise he will not be able to compete with the white race in the economic struggle for land or the political struggle for power."

This is a sad conclusion, but it is that which is supported by the history of both the Red and the Black races, and is that which is illustrated by the histories of so many of the Polynesian islands, where the circumstances were most favorable to the development of the best relations between the natives and the Europeans. The psychic traits of races are as unalterable as the shade of their hair, and inevitably for them define the future of their stock and limit its possibilities.

The Land Fu-Sang.

Now that the discussion of the various discoveries of America is in order, that which is referred to in Chinese annals as far back as the seventh century, in connection with the name Fu-Sang, should receive attention. It was first brought to the notice of scholars in 1761 by the French orientalist, De Guignes, and of course created some sensation. Various writers since then have warmly espoused his views, among whom may be mentioned in our own country Charles G. Leland and E. P. Vining, both of whom have issued volumes in proof of De Guignes's identification.

The *coup de grace* seems to have been dealt the theory by Gustave Schlegel in his book published in Leyden this year entitled "Fou-Sang Kouo; le Pays de Fou-Sang." He is a Chinese scholar of acknowledged competence, and takes up the story as recited in the original, with as many side-lights as he can bring to bear upon it.

The result of his researches is to knock every pin from under the notion that any part of America could have been intended in the description of Fu-Sang. As far as any real land can be discerned through the fog of exaggeration and fable which encircles the whole account, it is that of the island Krafto or Saghalien, and the people described resembled the Ainos more than any others. A variety of arguments are adduced to show that Mexico is out of all question; and therefore those fanciful archæologists who have been ready to find Buddhistic elements in American religions will have to look for them elsewhere than in the legend of Fu-Sang.

Another Failure in Ethnic Osteology.

The trenchant criticisms of Professor Sergi of Rome have already been referred to in these notes. He has recently published another of these in which he attacks and apparently demolishes the favorite theories of Professor Kollmann of Basel, in relation to the analogy existing between the face and its members. The latter has long maintained that there is a constant correlation between the elements of the face of such a nature that to long faces correspond high orbits, narrow nasal apertures, and elongated palatine vaults; and to wide faces the converse of these characters; and that the types of races expressed in head-forms will be a composite of the cephalic and facial indices.

Professor Sergi arrives at quite a different conclusion. He points out from various series of skulls that in the purest types the craniological criteria vary very widely. In every race individual examples present the utmost diversity. As to any fixed correlation between the shape of the face and the facial indices, which is the *crux* of Kollmann's argument, it is a pure chimera. He presents a series of measurements, tabulated from African and American crania, which leave no doubt as to the accuracy of his assertions; and Dr. Colignon, who reviews his work for *L'Anthropologie*, accepts its conclusions as incontrovertible. This is another serious blow to that department of physical anthropology which has set up a few anotomical features as more important than those of language and mind, as criteria of peoples.

WE are informed that in view of the general interest awakened in the cholera, Dr. Klein's well-known little book on "The Bacteria in Asiatic Cholera," published by Macmillan, has been reduced in price to one dollar. Dr. Klein is lecturer at St. Bartholomew's Hospital, London.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

A Pre-Aino Race in Japan.

IN the Report of the National Museum for 1890, just issued, are two papers by Romyn Hitchcock, entitled respectively, "The Ancient Pit-Dwellers of Yezo" and "The Ainos of Yezo, Japan." In these papers he advances the idea, which he evidently thinks is new, that there was a race of people in Japan previous to the Ainos, and these people he identifies with the Pit-Dwellers of Yezo. He says, "it has been supposed that the shell-mounds were left by the Ainos. This is the opinion of Professor John Milne." Mr. Hitchcock further says, "It has recently been shown by the researches of Milne, Morse, Chamberlain, and others that Japan proper was once inhabited by a race of people different from the present Japanese, and from the comparison of the remains found in shell-heaps and kitchen-middens in many parts of Japan, even as far south as Kiushiu, with similar remains found in Yezo, it is thought that the Ainos once inhabited Japan." It is hardly necessary to inform Mr. Hitchcock that the writers above mentioned did not require the evidences of shell-heaps to convince them that the Ainos inhabited Japan, as historical records in that country fully establish the fact. I have always maintained, however, and in one case with an acrimony which I now regret, that all the evidences point to the existence of a race occupying Japan previous to the Ainos, citing these very shell-heaps as proof. I am not concerned with the fact that he has overlooked my views published at different times on the subject, but I do object most emphatically to being represented by Mr. Hitchcock as holding views directly the reverse of what I have repeatedly urged; and as the point of a Pre-Aino race in Japan, if established, is of some value, I do not intend to relinquish it unless other claims to priority can be shown. While Mr. Hitchcock has not taken the trouble to look up my papers on the subject, he cannot plead ignorance of my views, as he has made most ample use of a memoir by Mr. Basil Hall Chamberlain, published by the University of Tokio, and should have seen the following statements in that publication (p. 44). Mr. Chamberlain says: "Two theories may be held with regard to the former presence of the Ainos in Japan. One is that they have occupied the whole country before the arrival of the Japanese. This theory has been advocated by Professor Milne. . . . The arguments used by Professor Milne are chiefly derived from archæological finds. . . . To his arguments, which should be consulted at some length, . . . it has been objected by Professor Morse . . . that there is no positive proof that the remains attributed by him to the Ainos may not have been left by some still older race." There is, therefore, no excuse for this oversight or blunder on the part of Mr. Hitchcock.

Fifteen years ago I sent from Japan a communication to *Nature* of London, entitled "Traces of Early Man in Japan." In this I said: "The examination of a genuine kjoekkenmoedding, or shell-heap, enables me to give positive evidences regarding a prehistoric race who occupied this island." And when I designated this race as pre-historic, I supposed every one familiar with Japanese history was aware of the fact that the Ainos had preceded the Japanese in Japan, as the Indians had preceded the English in New England. Hardly a popular book on Japan had failed to allude to the fact, quoting early records of the Japanese in proof of it. Over thirteen years ago I sent an article from Japan to the *Popular Science Monthly*, entitled "Traces of an Early Race in Japan." This was published in the January number, 1879, and contained numerous engravings. In this paper I said: "With every reason for believing that the Japanese came from the south, displacing the Ainos, who came from the north, the question next arises as to the original occupants of the island. Did the northern people encounter resistance from a primitive race of savages, or were they greeted only by the chattering of relatives still more remote, whose descendants yet clamber about

the forest-trees to-day? The records are silent upon these points. A discovery that I made in the vicinity of Tokio last year leads me to believe that possibly the traces of a race of men previous to the Aino occupation have been found." Again I say: "The next question arises as to whether the deposits are Aino or pre-Aino. The race who left these remains were pot-makers *par excellence*. It is generally admitted by ethnologists that the art of pottery once gained is never lost. It is a fact, however, that neither the Esquimaux, Aleutians, Kamtchadales, nor the Ainos are essentialy earthen pot makers." And, again, having shown incontestible proofs of the evidences of cannibalism in these deposits, I ask, "Were the Ainos cannibals? Repeated inquiries among eminent Japanese scholars and archæologists, like Mr. Kanda, Mr. Ninagawa, and others, as to this question, are always answered in the same way. Not only were they not cannibals, but they are reported as being so mild and gentle that murder was never known to have occurred. So monstrous a habit would certainly have been known and recorded, particularly in the painstaking annals of early historians."

In the Proceedings of the American Association for the Advancement of Science for 1878 occurs in the list of papers read by title the following one of mine, entitled "Evidences of Cannibalism in a Nation before the Ainos in Japan." A foot note states that this paper was published in the Tokio *Times*

In the year 1879 the University of Tokio published my memoir on the "Shell Mounds of Omori," illustrating the various forms of pottery, bone implements, etc., by seventeen folded plates. While this memoir is devoted exclusively to a minute description of the Omori deposits as a basis of comparison with material that I had on hand for the description of other shell-heaps, yet I urged the evidence of the deposits not having been made by Ainos, but by a race anterior to the Ainos, and cited especially the evidences of cannibalism as bearing on this point.

Twelve years ago I had occasion to criticise and controvert (*American Naturalist*, September, 1880), in the most emphatic manner Professor Milne's views as published in the Transactions of the Asiatic Society of Japan. At the same time I also showed, as I believed, the fallacy of the views of Henry von Siebold on this question. Thus in various publications in 1877, 1878, 1879, and 1880 I have urged the existence of a pre-Aino race in Japan.

Had Mr. Hitchcock taken the trouble to give proper credit to others who had worked in this field, he would have found additional support to the position he takes; as it is, his paper is marred by misapprehension and by the injustice of these omissions.

EDWARD S. MORSE.

Salem, Mass., Aug. 30.

On the Fundamental Hypotheses of Abstract Dynamics; From Another Point of View.

THERE is at present very little agreement among physicists or philosophers as to the nature of the hypotheses or laws upon which dynamics is based. On Aug. 5 Professor MacGregor expounded one view of the matter in these columns; but as I cannot but think his view contains some logical imperfections, I wish to lay before your readers a different view with which to compare it. For this is not a question to be settled by authority; the arguments on either side are after all simple enough, and, having studied them, any man of average attainments is capable of weighing them and forming his own opinion.

The principles of abstract (subjective) geometry may be deduced from definitions of the terms "Position" and "Direction,"[1] together with certain axioms asserting the conceivability of geometrical figures and constructions. Even without these axioms a symbolic geometry might be deduced, whose conclusions, however, would be mere truisms, or verbal assertions, till they were given a meaning by the axioms. To proceed to the objective geometry of material space, we require in addition certain inductions; which, however, are so complete that no practical doubt remains as to their validity.

[1] See my "Foundations of Geometry," Deighton, Bell, & Co., Cambridge, Eng., 1891.

In the same way we may treat kinematics from three different points of view. Symbolically, it is sufficient to define Time implicitly by the assertion, "The positions of points are all continuous single-valued functions of the Time." This definition may be given a subjective meaning by the axiom, "Particles are conceivable in Time," and an objective meaning by an induction proving that "material particles exist only in Time." i.e., their positions are continuous single-valued functions of a certain variable, which we may call Time.

To proceed to kinetics symbolically, we require definitions of Mass and Force. The only connotation symbolically required for the former term is "Mass is *not* a function of Space or Time." The latter term may be defined implicitly by assertions equivalent to Newton's laws of motion, which may be stated thus: —

1. The resultant force on any particle in any direction, referred to a given set of axes, is the product of the measures of its mass and its acceleration in that direction.

2. All forces go in pairs between pairs of particles, equal forces in opposite directions acting on the particles respectively in the line joining them. (Such a pair of forces may be spoken of as a stress.)

It is evident from 1, since mass is not a function of space or time, that forces, like accelerations, are vectors, and may be compounded by the parallelogramic law. Paragraph 1, however, only speaks of resultant forces, and the actual, or acting, forces on any particle would remain entirely arbitrary but for paragraph 2, which must be read in conjunction with 1. Professor MacGregor asserts that paragraph 2 is not consistent (i.e., *might* be inconsistent) with 1. So far from this being the case, I propose to show that it still leaves the term Force to some extent arbitrary. The stresses between particles are not completely determined, even with reference to a given set of axes; and, moreover, both Force and Stress are relative to the axes chosen.

In geometry and kinematics both position and direction are relative terms. To determine a position we require to know its distance and direction from a given position. To know its direction we require to know the inclination of that direction to two given (independent) directions, and, in addition, which side it is of the plane determined by them.

Suppose, then, we have a set of particles numbered from 1 to n. Choose the first particle as origin of a system of rectangular coordinates; the direction 12 as that of the axis of x; the direction at right-angles to this in the plane 123, and on that side of the line 12 on which the particle 3 lies, as that of the axis y; and the direction perpendicular to the plane 123, on that side of it on which the particle 4 lies, as that of the axis z. Thus we have determined a set of axes completely, and in doing so we have made the six arbitrary assumptions: —

$$\left.\begin{matrix} x_1 = 0 & y_1 = 0 & z_1 = 0 \\ & y_2 = 0 & z_2 = 0 \\ & & z_3 = 0 \end{matrix}\right\}$$

Now let F_{rs} be the stress between the particles r and s, being positive if they attract, negative if they repel one another. Then considering forces acting on particle 1 we have the equations —

$$F_{12}\frac{x_1 - x_2}{r_{12}} + F_{13}\frac{x_1 - x_3}{r_{13}} + \cdots\cdots = -m\ddot{x}_1,$$

and two similar equations with y and z (r_{12} being the distance between the particles). Thus in all we have $3n$ equations between $\frac{n \cdot n - 1}{2}$ quantities F_{12}, F_{13}, etc. But these equations may not all be independent. As, however, they contain $(3n - 6)$ independent variables, x_2, x_3, y_3, etc. (the other six having been arbitrarily equated to zero), there will in general be $(3n - 6)$ of them independent. If they only just sufficed to determine the quantities F_{12}, F_{13}, etc., we should have

$$\frac{n \cdot n - 1}{2} = 3n - 6.$$

Whence $n = 3$ or 4. Therefore, if n is greater than 4 (which, of course, it is), the equations must be insufficient to determine the quantities; that is, the stresses remain to some extent arbitrary;

hence the two assertions about Force are arbitrary and may be laid down as a (partial) definition of that term.

From this definition all the theorems of dynamics may be deduced, as from Newton's laws of motion. The theorems of statics may also be deduced, the only difficulty being the principle of virtual work. This difficulty, however, disappears as soon as the term "geometrical conditions" is properly defined.

We have then a symbolic dynamics. To give it a subjective meaning we have to conceive a real denotation for its terms. It is not, however, necessary to give a real denotation to Force if we can do so to Mass, for we may still regard Force as merely a name for the product of mass by acceleration, or (which is the same thing) as the time-flux of momentum. To give the theory an objective application it is necessary to show that what we call material particles not only occupy positions which are continuous one-valued functions of what we call Time, but also possess a certain characteristic which is not a function of space or time, and which may be called Mass. Then, whether we attach any denotative meaning to Force or not, we can discuss the forces or stresses that must be postulated between various particles of matter. The magnitudes of these will in general depend on the axes we assume by which to determine positions, and also on the masses assigned to the various particles. The axes and masses are therefore assumed in such a way as to make the resulting system of stresses the simplest possible. For example, it is generally assumed that the stress between any two particles diminishes as the distance between them increases, and may be neglected if this distance is very great. Hence in astronomy the attractions of the fixed stars on the planets may generally be neglected, and we may discuss the solar system alone. It is further shown that the system of stresses between the sun and planets is simplest when a certain plane is taken as "the invariable plane." But we do not really *know* that the stresses thus deduced are the actual ones, or indeed that there is any actual phenomenon corresponding to what we call stress at all. Any plane might be chosen as the "invariable" one, at the cost of having to postulate a more complicated system of stresses. We cannot determine fixed directions dynamically, any more than kinematically, except by making assumptions which are really arbitrary about the stresses between certain particles.

As Professor MacGregor points out, the law of the conservation of mechanical energy would flow from the assumption that stresses are functions of the distances between the particles on which they act. But this would not include the general law of conservation of energy until all energy was shown to be mechanical energy. And even then, on the above assumption, the term conservation of energy would be rather misleading; for the kinetic energy is not conserved unless the term potential energy is merely used as a cloak to hide our ignorance of kinetic energies which for the moment have passed beyond our ken. For example, a few years ago it might have been said that when we project a keeper away from an electro-magnet, the kinetic energy with which it starts becomes converted into potential by the time it stops, just as when we throw a stone into the air. But if, while the keeper is at a distance from the magnet, the current is switched off, that potential energy is *abolished!* The true view is, however, that there never was any potential energy at all, the energy of the flying keeper had its equivalent in an increase in the electric current round the magnet — a kinetic, not a potential, energy. And I have no doubt that some day science will show a similar explanation to hold with respect to gravitation and other actions at a distance. When that day comes the term "potential energy" may be banished to "the limbo of once useful things."

It will be seen, therefore, that I differ from Professor MacGregor chiefly in denying "the non-relative character of Force." Professor MacGregor says, "it is easy to show that if it [the third law of motion] hold for one point of reference, it cannot hold for another having an acceleration relative to the first." I should like to see his proof; but if he refers accelerations to a single point, I can well understand that he should arrive at results inconsistent with mine. For, as I have shown, the apparently absolute determinations of direction depend in reality on arbitrary assumptions as to stresses. Having made these arbitrary assumptions, it may well be impossible to further make arbitrarily the assumptions involved in the third law of motion.

I cannot quite follow his paragraph beginning "It may easily be proved that the stress between two particles is proportional to the product, by the sum of their masses into their relative acceleration." There seems to be some misprint; but how a single particle could in any case exert all the forces acting on a system of particles, I cannot understand, unless the words "equal and opposite" in the third law of motion are not held to imply that the forces act in the line joining the particles, which, moreover, is distinctly implied in the Professor's law of stress. In any case the difficulty referred to above comes in again, viz., that we cannot determine directions absolutely, or positions by reference to a single point.

In conclusion, I should like to point out that it seems inconvenient, even if Professor MacGregor's views be accepted on other points, to include in one law of stress, two statements resting on such very different evidence as that forces may be considered to be attractions or repulsions, and that their magnitudes depend solely on the distances between the particles on which they act. It would give a student a very false notion of the fundamental hypotheses of dynamics to teach him that he must accept or reject both these assertions together. EDWARD T. DIXON.

Cambridge, Eng., Aug. 20.

The Fundamental Hypothesis of Abstract Dynamics.

PROFESSOR HOSKINS points out (*Science*, Aug. 26, p. 122) that for the conservation of energy the necessary and sufficient condition is that ΣPdr shall be a perfect differential of a function of the quantities r, P being the stress between any two particles of the system, and r their distance; and that the condition that each P shall be a function of the corresponding r only, which I suggested for adoption as a fourth law of motion, with a view to the deduction of the law of the conservation of energy (*Science*, Aug. 5, p. 74), while sufficient, is not necessary.

There are three reasons which influence me in selecting for the fourth law an hypothesis which is more than sufficient for the main purpose in making the selection, viz., (1) that it is capable of simple physical expression, (2) that it is already known to hold in the case of several natural forces, and (3) that the additional assumption involved in it, over and above that necessary for the deduction of the conservation of energy, is one which is, I think, invariably made in investigations on the laws of natural forces.

What the additional assumption is, is readily seen. In a system of two particles A and B, ΣPdr becomes Pdr; and in this case it is both necessary and sufficient for the conservation of energy that the single stress acting shall be a function of the distance AB only. If we add a third particle, C, to the system, conservation no longer requires that the stress between A and B shall be a function of the distance AB only, though it is secured if that condition is fulfilled. Thus the proposed law assumes, in addition to what is required for conservation, that the stress between A and B is not changed by the fact that other stresses have begun to act between A and C and between B and C. The proposed law therefore involves an assumption similar to that implied in Newton's second law. As Newton's law assumes that a force produces the same acceleration in a particle whether other forces act on it or not, so the proposed law assumes that the stress between two particles is the same whether or not there are other stresses acting between them and other particles.

That this additional assumption holds in the case of some natural forces has been abundantly verified, and in investigations into the laws of forces not yet determined, so far as my knowledge of such investigations goes, the same assumption is always made. This being so, we would seem to be warranted in adopting, tentatively of course, as a fourth law of motion an hypothesis in which this assumption is implied. The proposed law cannot be said to have received anything like the verification that Newton's laws have received. But of the many deductions which have been made from it, none have been contradicted, while many have been corroborated, by experience. J. G. MACGREGOR.

Shubenacadie, N.S., Sept. 2.

The Nomenclature Question.

I AM glad to see this question brought up as it is by Professor Underwood in the number of *Science* for Aug. 26; for we should have a uniform nomenclature in all departments of natural history. That such is not the case now is apparent to every student who is working in any of its various branches. But I do not wish to discuss the subject in general, but to touch upon one or two points. As to the question of priority, there should be some definite rules by which this should be governed, as has already been said in other of our scientific periodicals, and it will not profit by any re-hashing it here, further than to say that among entomologists it is generally understood that the mere proposal of a name for a genus without characterizing it does not hold against a later name accompanied by a description.

As to the act of a writer who takes a species already named and puts it into a new genus with his own name after it instead of the name of the original describer, that is an outrage that has not been tolerated among entomologists for some time. I can see no valid reason for retaining such a system of nomenclature in any department of natural history, merely that some reviser may gain a little cheap notoriety.

A word as to the initial letter of specific names. It seems to me that the name of a species is a proper name as much as the name of a genus; in other words, it is the name of a group of plants or animals, and, if such, is as much entitled to a capital initial as is the name of the genus. Many of our leading entomologists have adopted this view and begin all specific names with capitals; as, for instance, see Edwards's "Revised Catalogue of the Diurnal Lepidoptera of North America," 1884; Kirby's "Catalogue of Diurnal Lepidoptera," 1871 and 1877, etc. I believe it is the correct principle and follow it in all my work in natural history.

G. H. FRENCH.

Southern Illinois Normal, Aug. 30.

The Grand-Gulf Formation.

THIS has now become a clearly recognized division of the post-eocene geology of the Gulf States. No subdivisions of it have as yet been attempted in print, though more than three years have elapsed since the writer — then in the service of the U. S. Geological Survey — announced the first discovery of fossils on Pascagoula River and the two branches which form it, Leaf River and the Chickasawhay, near their junction. The exact locality of the largest deposit is Shell Bluff, just below Robert's Ferry and a few miles south-west of the post-office Vernal, in Greene County, Mississippi. It was then proposed to call it the Pascagoula formation, and to regard it as distinct from Dr. Hilgard's Grand-Gulf. Further developments and recent discoveries have confirmed me in this view. It was not at first accepted, because there is but the one witness, myself, and attempts to trace it westward and eastward failed to detect the same or similar fossiliferous beds on the Mississippi, on Pearl River, on the Alabama River, or on any of the smaller streams of these States. This kind of negative testimony would only go to restrict its extension, and not to overthrow the validity of the distinction if otherwise properly established.

Many facts, too numerous to be elaborated in this short paper, prove that the great Mississippi embayment had collateral branches in which the variations are too well defined to be disregarded. The Pascagoula embayment was one. And whilst the main body of the Grand-Gulf formation is of sand, sandy clays, and quartzites due to a fresh-water agency, in the Pascagoula formation it presents a marine aspect, where calcareous clays, more or less pure and with more or less distinct evidence of molluscan fossils, prevail. The boundaries of these two will not be attempted in this paper. Let us pass at once to some of the strongest and more recent proofs.

Of the shells discovered at Shell Bluff it may be said only one, the large oyster, could be clearly determined. The rest were in a condition so decayed and friable as to render their transportation in good condition impossible. But as I remember them, the oyster approached, yet differed from, the recent *O. Virginiana*, among other particulars, in its greater massiveness. Among the other shells too rotten to be moved was one strongly similar to a *Gnathodon*, though it may turn out to be a *Mactra*. Another, and the most numerous, was a small shell somewhat resembling in size and outline the *Donax* so common on our beaches, but with less umbonal development, and with the distinctly visible lines of growth resembling *Venus*. The difficulty in this case as well as the other is that the hinge could not be clearly made out.

Borings for artesian wells at Biloxi and other places on the Mississippi coast, and quite recently at Mobile, Ala., solve the difficulty.

The Biloxi borings, among other things, brought up, from a depth in the neighborhood of 700 feet, fragments of a large oyster, which might well belong to that of Pascagoula, and a very easily recognized *Gnathodon*.

The boring at Mobile, from about the same depth and just above the water-bearing sands, has yielded similar bits of oyster, and a small shell, evidently the same as that of Pascagoula, and sufficiently preserved to be determined. It is a *Venus*, or very nearly allied to that genus, and if not already found elsewhere and named, the name *V. Mobilensis* is proposed for it.

Not having room to go further into detail, I wish clearly to say that I find evidence sufficient to establish the existence of a formation of deep-bedded gray clays of partially marine genesis, lying upon the water-bearing sands of the upper strata of the Grand-Gulf formation; that I have traced this clay from Pearl River, Miss., to Conecuh River, Ala.; that it constitutes the cover rendering artesian wells possible, and that it was for these clays that the name Pascagoula was proposed.

LAURENCE C. JOHNSON.

Meridian, Miss., Aug. 1.

European Origin of the Aryans.

My attention has been called to Dr. Brinton's note in *Science* for June 20 as to the claim of Omalius d'Halloy to have preceded Latham in calling in question the theory of the Asiatic origin of the Aryans. In 1890, when in his lectures on "Races and Peoples," Dr. Brinton advanced the claim of d'Halloy, I carefully read over Halloy's articles, as cited by Dr. Brinton on p. 146 of his book, and I came to the conclusion that d'Halloy was not acquainted with the theory he is said to have controverted. The dates confirm this conclusion. The articles in question were published in the Bulletins of the Belgian Academy during the years 1839 to 1844, and were recapitulated in 1848. The theory of the migration of the Aryans from central Asia first found definite expression in an article by Pott, buried in a volume of Ersch and Grüber's Encyclopædia, which was published in 1840, but it attracted no attention till taken up by Lassen in 1847, and by Jacob Grimm in 1848. This was the theory against which Latham contended, whereas d'Halloy's very confused and misty arguments seem to refer, if they refer to anything, to the Caucasian theory broached by Blumenbach in 1781, with the modifications proposed by Adelung in his Mithridates, 1806-1816.

I think, therefore, we are still justified in asserting that Latham was the first to question the comparatively modern theory that the Aryan race originated in the highlands of central Asia, a theory of which d'Halloy does not seem to have heard, and consequently in the second edition of my "Origin of the Aryans," published in 1892, I did not think it necessary to modify my former statements as to Latham's priority.

ISAAC TAYLOR.

Settrington, York, England.

Acid Prevention of Cholera.

IN previous epidemics the value of sulphuric and sulphurous acids as preventives was demonstrated, and when Koch discovered his comma bacillus he also noted that its cultivation was possible only in alkaline media, and that acids destroyed it. In corroboration of these findings, Niemeyer, who wrote long before anything of this nature was known, records that the ileum, or lower small intestine, is the main seat of the pathological changes caused by cholera. This lower small intestine is the most alkaline and the farthest from the normally acid stomach. The large intestine, being acid, does not suffer.

In view of these discoveries it would be well to establish an acid condition of the system by ten or fifteen drops of sulphuric acid to the quart of water used as lemonade — the water previously boiled,— and observe if sour wines might not be better for those in the habit of drinking liquors, also as to whether gout and rheumatism, which are acid diatheses, conferred immunity.

S. V. Clevenger, M.D.

Chicago, Sept. 5.

Mars.

At the present time, while theories and suggestions concerning the planet Mars are in order, it might be well to note that, on a study of Schiaparelli's chart of Mars, the systems of so-called canals resolve themselves, in many cases, into radiating groups of six, making hexagons, and giving the idea that the planet may be solidified into a mass with tendency to hexagonal crystallization, the "canals" being, for instance, fissures on the lines of the angles of crystallization. This would account for many of the peculiarities of their appearance, while in no way opposing the present existence of atmosphere, water, snow, ice, and vegetation on the planet.

C. W. Kempton.

Oro Blanco, Ariz., Aug. 25.

La Grippe.

The name *La Grippe* as used to designate the influenza, which was epidemic over so large a part of the world during the past two or three years, seems to have had a curious origin. Dr. Grant, in an essay on the disease published in 1782, states that the French term *La Grippe* is derived from an insect of that name remarkably common in France during the previous spring, and which the people believed contaminated the atmosphere, and caused the disease. If this be true, what insect was it?

M. L. Holbrook.

New York, Aug. 29.

BOOK-REVIEWS.

A Journal of American Ethnology and Archæology. Editor, J. Walter Fewkes. Vol. II. Boston, Houghton, Mifflin & Co. 1892.

This volume is issued as one of the publications of the Hemenway South-western Archæological Expedition, and embraces, I., A Few Summer Ceremonials at the Tusayan Pueblos, by J. Walter Fewkes; II., Natal Ceremonies of the Hopi Indians, by J. G. Owens; III., A Report on the Present Condition of a Ruin in Arizona Called Casa Grande, also by Dr. Fewkes.

Dr. Fewkes, the editor of the journal and the author of two of the contributions to this volume, has treated the subject of the Tusayan ceremonials with much greater success than were treated the Zuñi rites, to which he devoted much of the first volume.

The province of Tusayan, or so-called group of Moki Indian pueblos of north-eastern Arizona, owing to their remoteness from the demoralizing influence of the white-man's civilization, are among the most primitive of our aboriginal tribes, and Dr. Fewkes has made no mistake in abandoning the Zuñi field (to which he devoted his first field-season, and to which the attention of such workers as Mr. F. H. Cushing and Mrs. M. C. Stevenson had earlier been drawn) in order to apply all his energies to this interesting people. So far as ethnologic investigation has proved, the Tusayan group (excluding the Tewa village of Hano) is the only existing example of a nomadic people adopting a strictly pueblo life — for the Mokis, or Hopi, are a part of the great Shoshonean stock; cousins of the Utes, the Snakes, and the Comanches, and who, centuries ago, were disconnected from the main family and forced to these mesa fastnesses, where they erected communal structures of stone and mud, and cultivated corn, squashes, cotton, and other products in the sand-spread plains below.

Many of the ceremonials described by Dr. Fewkes in this volume have evidently been borrowed by the Tusayan from the

various Rio Grande tribes and from the Zuñis — those from the former doubtless through the Tewa who fled from the Rio Grande during the great Pueblo revolt against Spanish authority in 1680–96. Borrowed ceremonials, however, undergo great changes, as exemplified by the "ghost dance" or "Messiah craze" now so general among the tribes from the British possessions to the Mexican frontier; hence it is not improbable that many of the Tusayan dance-dramas, which originated, say, in Zuñi, are now recognizable only by the corrupted Zuñi names which they still retain.

A number of the similarities of the Zuñi and Tusayan summer ceremonials are shown by the author, the performers and their paraphernalia minutely described, and many interesting features brought to light. The paper is a valuable contribution to science. The time for original research among the Pueblo tribes is rapidly disappearing, and, happily, Dr. Fewkes is losing no time in placing before the scientific world the results of his observations.

The second paper — Natal Ceremonies of the Hopi Indians, by Mr. Owens — is a very pretty portrayal of the birth-rites of the Tusayan, or, as they call themselves, the Hopi Indians, and many interesting facts are made known. Mr. Owens, who was Dr. Fewkes's field assistant, records these ceremonials without attempting their probable interpretation — a wise precaution, since, without at least a fair knowledge of the native tongue, or an intimate acquaintance with the Indians themselves, the results might otherwise have been misleading.

Ever since the first establishment of missions by the Jesuit Father Kino, in southern Arizona, in the 17th century, the civilized world has been treated to descriptions of Casa Grande, a massive ruined adobe structure a short distance from the banks of the Rio Gila. Some of the authors aver that this noble old building was the birthplace of Montezuma, and on many of our maps of the latter half of the last century it is noted as the second stopping-place of that monarch on his way from Aztlan! Several authors agree in identifying it with Chichilticale, a ruin mentioned by Vasquez de Coronado in 1541; but this Bandelier denies on the ground that the course of that *conquistador* lay farther east. Dr. Fewkes has supplemented the information given by Bartlett, and later by Bandelier, Hinton, and others, with a description of the present appearance of Casa Grande, accompanied by a number of excellent illustrations and a ground-plan on which various measurements are given. A reference, on page 189, to what appears to be an accidental clogging up of an opening in one of the walls by debris fallen from above, should not stand uncorrected. The massive and symmetrical block of abobe referred to and figured in one of the cuts is a door "close," examples of which, but generally of stone, are frequently found in our south-western ruins, and which were formerly in use by the Zuñi Indians. Indeed, the Zuñi name for door is but a survival of the term, now obsolete, of course, for stone-close; i. e., when door were introduced, doubtless by the Spaniards, they were still closes to the Zuñi mind, and since their name for a close was, literally, "stone close," their name for a wooden door became "wooden stone-close," a name which is retained to this day. The block of adobe was a close, and was fashioned to fit the opening of the wall, thus forming a cumbersome but sure means of defense.

The volume is a model of typography, and it is illustrated generously and well F. WEBB HODGE.

Washington City.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

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N. D. C. HODGES,
874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
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Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
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Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
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Jassidæ; Notes on Local.
Keller, Helen.
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Weeds as Fertilising Material.
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Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

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SCIENCE

NEW YORK, SEPTEMBER 16, 1892.

DANGER FROM THE POPULAR MISUSE OF QUININE.

BY W. THORNTON PARKER, M.D

A RECENT editorial in the *Medical News* of April 2, 1892, concerning deaths from cocaine, may well be noticed in connection with the investigation of dangers from the popular misuse of quinine. "I have never seen it," *ergo* "No man's experience, however wide, can cover all the possibilities of disease and accident. It may be well and wise for one to say. 'I have not seen it,' when the possibility or likelihood of this or that pathologic or toxic accident is under discussion; but it is never wise and never well because of the perhaps limitation of one's own experience to deny the reality of occurrences vouched for by competent observers, and not in themselves incredible."

A recent item in one of the daily journals has prompted me to say a word against the misuse of the popular remedy known as quinine. The item referred to states that a sea-captain, sailing his craft too near a sunken ledge, was warned to give the dangerous quarter a wide berth. He replied, by yelling out at his adviser, "You go straight to hell; I am sailing this craft where I —— please." The vessel was wrecked, and the insurance money refused on the ground that the captain wilfully destroyed his vessel. This the defence emphatically denied. In explanation of his extraordinary language, the captain stated that he had been suffering from malaria, and had taken large doses of quinine for relief, and had become so much "influenced" by its action that really he did not know what he was saying or doing.

Few, if any medicines, enter so largely and generally into popular use as quinine. Throughout the world we find it almost everywhere for sale; it can be purchased in any quantity by anybody, and used as the purchaser may think best, in larger or smaller doses, at intervals, or continually. Few seem to understand its poisonous action, or even suspect that its continual use can result in any special injury to the system. It is prescribed by all sorts and conditions of men, women, and children. Ruse, in his excellent text-book of medical jurisprudence, defines a poison as "a substance which, when introduced into the body by swallowing or by any other method, occasions disease or death; and this as an ordinary result in a state of health, and not by a mechanical action. It must be as an ordinary result; a substance, for example, which affects one person injuriously through idiosyncrasy, is not to be called poison. Again it must be *in the healthy system*, as is well known, many diseases render the system extremely susceptible to impressions by external agents, e. g., in gastritis, the blandest substance, even water, may excite vomiting."

The action of the malarial poison upon the system is of such a nature that many would claim that any abnormal nervous impression would be more likely to have its origin in the malarial poison than in the quinine, which is given with a view to neutralizing that poison. We know of so many diseases following the inception of the malarial germs that any attack upon quinine, as a poisonous remedy, may reasonably expect prompt resentment. Ringer states, that "large doses produce severe frontal headache with dull, heavy, tensive, and sometimes agonizing pains. While these symptoms last, and, indeed, generally before they appear, the face is flushed, the eyes suffused, and the expression is dull and stupid. Even small doses in persons very susceptible to the action of this medicine will produce some of the foregoing symptoms, especially the headache and mental disturbance. Many of these symptoms are, no doubt, due to the action of quinia on the brain. In toxic doses it excites convulsions. Chirone and Curc find that the removal of the motor centres of the brain prevents these convulsions; and, if the central hemisphere is removed on one side, the convulsions are unilateral. Albertoni, on the other hand, finds that quinia will induce convulsions when the central hemisphere or the cortical motor centres are removed." Dr. Bartholow states, that "In full medicinal doses, as the quinia accumulates in the brain, a sense of fullness in the head, constriction of the forehead, *tinnitus aurium*, more or less giddiness, even decided vertigo, may be produced. In actually toxic doses all of the above symptoms have been intensified. There are intense headache with constriction of the forehead, dimness of vision, or complete blindness, deafness, delirium, or coma, dilated pupils, weak, fluttering pulse, irregular and shallow respiration, convulsions, and finally collapse and death." Dr. Wood states, that "The minimum fatal dose of quinine is not known, but it must be large, and probably varies very much." Brown-Sequard states, that "In epileptics the attacks are rendered decidedly more frequent by the cinchona alkaloids." Dr. Wood is of the opinion, also, that "In large doses quinia, without doubt, abolishes the functions of the cerebrum."

From the foregoing we have evidence to demonstrate that quinia is too dangerous a remedy to be prescribed recklessly by medical men, and that its popular use by people ignorant of its action should be condemned and, if possible, prevented. In our own practice we have known of four cases where moderate doses continued even for two or three days would produce serious cerebral disturbance amounting to almost homicidal mania. There are very many cases in every community where the use of quinine will affect the nervous system of patients in a serious manner. One patient, after using ten grains, did not know whether it was morning or evening, and was bewildered in finding his way home. Another complained to me that he could not take quinine without feeling cross and out of sorts for a week afterwards. Still another, a very peaceful man naturally, stated that the use of quinine for a day or so made him quarrelsome and pugilistic, and he feared that under its influence he might commit some act which might bring him into serious trouble. Supposing that a lawyer should offer in defence of his client the statement that, acting under the advice of his physician, the patient had been taking large doses of quinine for several days, and in a paroxysm of rage, while under the influence of the drug, he had committed homicide, would this man in equity be responsible for his deed? That quinine is a dangerous drug with many there can be no doubt, that it is universally dangerous there may be some question. It seems to me but just, under the circumstances, that it should be rated as a poison. The study of the action of quinine, from a medico-legal standpoint, is one, therefore, not without interest.

POPULAR ERRORS ABOUT WILD ANIMALS.

BY THEODORE B. COMSTOCK.

IN the issue of the *Popular Science Monthly* for September, 1892, at page 719, is the following item under "Notes": —

"A novel view of the puma, or panther, as it is commonly called, is taken by Mr. W. H. Hudson, in his 'Naturalist in La Plata,' who insists that it never attacks men except in self-defence. In the pampas, where it is common, the *gaucho* confidently sleeps on the ground, although he knows that pumas are close by; and it is said that a child may sleep on the plain unprotected in equal security."

There are many popular notions concerning the danger from wild animals which everyone who has travelled out of the beaten

paths has come to know as groundless. The puma, or American panther, and its South American representative, the jaguar, are not regarded by experienced hunters and naturalists as animals to be feared, excepting under circumstances which leave no avenue of escape open to the beast. The writer has repeatedly observed this fact in connection with the puma in this country, with the jaguar in the forests of the Amazon, and with various other wild animals, in both regions, which are terrible antagonists when brought to bay by wounds or other events demanding defence of self or young. The puma plays like a cat about the lonely traveller on foot or snow-shoes in the Rocky Mountains, and the curiosity of the jaguar brings him nightly to the camps of voyagers along the Brazilian rivers. I have often in that region been disturbed in sleep by such prowlers, who would rush suddenly off upon the slightest movement of my body; and upon numerous occasions in the morning fresh tracks in the sand all around our blankets would be visible, many times without our being awakened by the movements of the animals.

Mr. Hudson's remarks regarding the fearlessness of the natives in La Plata do not, however, agree with my own observations of the average Amazonian dwellers. As an instance, one night in 1870, at the Cachociras (waterfalls) de Maroim upon the Tocantins River, some 200 miles above the city of Pará, we encamped in the forest at the edge of the river, contrary to our usual custom of selecting a sandy island. Some in hammocks, others with blankets spread upon the ground, we North-Americans all slept soundly, notwithstanding that a rock cavern with well-gnawed bones and other signs of jaguar occupancy lay within 200 feet of the camp. I did awake once and saw the glaring eyes of a huge jaguar, as I supposed, within a few feet of my hammock. Next morning the tracks were evident in this particular spot, as well as many others all around camp, which were not there when we lay down at night. But the natives! Every mother's son of them uttered that night fervent prayers for protection, and sought rest in the tree-tops, swinging their hammocks from limbs hanging far out over the water, at the same time cautioning us of the great danger to be feared from vicious attacks of the tigers. This is only one of a number of similar instances, and not a little experience, with the puma and with bears of various kinds (including the cinnamon and grizzly) and other animals of reputation for unbridled ferocity, has brought me to the same conclusion regarding them. The writer called attention to the harmless nature of some supposed dangerous *feres* as early as 1873–74 in articles in the *American Naturalist* upon "The Scientific Value of the Yellowstone Park."

Venomous reptiles and insects, as the rattlesnake, "Gila Monster," tarantula, scorpion, centipede, etc., have reputations beyond their deserts for blood-thirstiness. Notwithstanding the numerous authentic cases of poisoning by them, I have yet to learn of one which cannot be fairly regarded as the *derrier resort* of the animal in a defensive attitude. Give any one of these creatures a reasonable (to their notion) chance of escape and they will avail themselves of it in preference to attack. One may come upon them suddenly, and unconsciously put them in a position from which no escape is open; but, if they are let alone or given a free field, they will always avail themselves of it. I remember the case of a rattlesnake in Texas, which we had surrounded and which was menaced by clubs upon all sides. He ran for dear life, striving his best to pass the gaps between each pair of enemies, until, baffled at every point, he suddenly turned upon the writer for an attack. As soon, however, as this manœuvre had opened a passage-way in one direction, he darted off and was again caught only with great difficulty. So, in Indian Territory, among the Wichita Mountains, where the rattlesnakes are akin to boas in size and hideousness, they are wofully sluggish. I have encountered them there among the rocks and in the tall grass, with the sickening rattle sounding long enough to get far from harm before the dangerous thrust was made. My horse has almost stepped upon them in such situations in that region, as well as in Wyoming, Texas, Arizona, and elsewhere, without further result than a scampering off of the snake. Much as the boa constrictor is dreaded in Brazil, cases are exceedingly rare of the exercise of its undoubted power over humanity.

The alligator, with all his ability to devour, is an arrant coward, and we often bathed in the tropical rivers where they were disporting themselves not far away. The natives there claim that none but drunken men are in danger from their attacks.

Hunger, endangerment of life, excessive fear of man with no means of escape, and a sudden surprise are all effective in bringing up every means of defence. The real danger from association with many of these creatures is the liability to meet them unawares, or to suddenly place them on the defensive through the unconscious movements of sleep. The more sluggish or the smaller the animal, the greater is this risk.

In Arizona the bite of a certain small species of skunk is very much dreaded, owing to the belief that hydrophobia is a probable result. There is almost no danger from this source, nor from the vile excretions of other species of polecat, if one does not directly attack them; but from their unfortunate sociability in this region, a sleeping person may suddenly throw out his hand when disturbed, without awakening. In nine cases out of ten this will drive off the intruder, who will rarely return. Occasionally, however, such an act may hit the animal, when he will bite as he flees. Very few cases of this kind have been reported. I have frequently discovered innumerable tracks of these animals about my cot of a morning when camping in sandy tracts, and sometimes have seen them moving about. A movement of the arm is always enough to send them post-haste to cover at a distance. Persons lying on blankets on the ground need more caution, as these "essence peddlers" will sometimes occupy such beds on cold nights.

Skunks are extremely abundant for several weeks in autumn in this region. Last year four of them entered the university itself, and at one point in the Baboquivon Mountains as many as thirty were killed near our cabin in two or three days. They would come up to the doors at midday, and as many as seven at one time were seen on moonlight nights within shooting distance.

These pests have again made their appearance this month. There seem to be four kinds of them, varying materially in "scentability" from the inodorous little biter to the one which is the very *quintessence* of malodorousness, and in color from a light gray to a dense black with white tail. Somehow or other, one of each kind inhabited a cosy nook beneath the writer's office last fall. The little gray one was particularly fond of intruding into my bed-room until the shot-gun was called into requisition.

Tucson, Arizona, Sept. 5.

CONCERNING THE AERATION OF MILK.

BY C. S. PLUMB, DIRECTOR AGRICULTURAL EXPERIMENT STATION OF INDIANA.

MUCH advance has been made in our knowledge of dairying of late years, and especially in America has there been much attention devoted to problems affecting the industry, which has resulted in remarkable progress. Some of the American agricultural experiment stations have made themselves best known by the dairy investigations they have conducted.

Among these subjects of study has been that of the influence of aeration upon milk. Milk fresh from the cow, that was aerated and suddenly reduced in temperature at the same time, it was claimed, would remain sweet longer than milk not so treated set under similar conditions. Within a comparatively short time aerating machines have been placed on the market, that are credited with removing disagreeable odors and retarding acidity of milk.

Bulletin 27 of the Vermont Experiment Station, for January, 1892, states that the "aerator gave good satisfaction" when in use at that institution. At the Cornell University Experiment Station the aeration and cooling of milk were studied by Professor H. H. Wing, and the results published in Bulletin 39, for July, 1892. In this it is shown that the Champion aerator will cool 225 to 250 pounds of milk per hour down to about 60° F. Milk passed over the Champion was, on an average, perceptibly sour in fifty hours after setting; that aerated on the Star machine was sour in fifty-one hours; while milk aerated with the Powell machine

soured in forty-six hours, the average length of time in which milk not aerated became acid. It was also shown that skim-milk from aerated milk contained .53 per cent of fat against .31 per cent of fat in skim-milk from milk not aerated; this milk was set in Cooley cans.

During April and May of the present year the writer, assisted by Mr. H. C. Beckman, an agricultural student in Purdue University, carried on a series of tests to note the influence of aeration upon the securing of butter-fat in milk, the details of which were presented to the Society for the Promotion of Agricultural Science, at Rochester, N.Y., on Aug. 20. Fifty pounds of fresh, warm, mixed milk was divided into two lots of twenty-five pounds each. Lot one was passed over an Evans and Heuling aerator and reduced in temperature, on an average, from 88.3° to 56.5° F. This milk was then set in cold water, and skimmed in twenty-four hours. Lot two was treated like lot one, excepting that it was not aerated. Twenty-nine lots of cream were secured from each class, which resulted in a total amount of 183 pounds 5¼ ounces of cream from aerated milk, and 181 pounds 10¼ ounces from that not aerated. Daily tests were made with the Babcock machine, which showed an average of 24.4 per cent fat in cream from aerated, and 24.0 per cent of fat in cream from non-aerated milk. Thirty-two pounds seven ounces of butter were made from the cream from aerated milk, and six ounces less from the non-aerated.

The limited amount of experimental evidence published would indicate that aerated milk kept sweet somewhat longer than that not so treated, other things being equal. Our practical observations seemed to point this way. In order to more carefully investigate this point, a chemical investigation of the subject was carried on under the direction of Professor H. A. Huston, chemist of the Purdue University Agricultural Experiment Station. The milks were treated as noted above, one lot being aerated and the other not. Check samples from each lot were taken every twelve hours. The relative acidity of the milks was determined by means of the quantity of one-half normal caustic potash required to produce a neutral tint. On account of the well-known amphegenic action of milk with litmus paper, it was considered desirable to obtain results with more than one indicator. After repeated trials with a large number of indicators, phenol-phthalein and corralline were selected. The milk was titrated at once after sampling. After the first twelve hours 5 cubic centimeters one-half normal HCl were added to 250 cubic centimeters of the milk; 25 cubic centimeters of this milk were taken for titration. Several methods of setting the lots of milk were tried. A synopsis of these tests, over equal periods of time, shows the following interesting results: In sixteen tests the aerated milk was most acid; in eleven tests the non-aerated milk was most acid; while in seven cases the acidity was equal in both lots. These tests, which represent considerable painstaking work, do not indicate the results from aeration that were to have been expected as based on current opinion.

If cows are properly fed and milked, the writer does not believe that normal milk will be disagreeable if set in clean vessels in sweet surroundings, yet there are those who lay great stress upon the animal odor in milk, and the necessity of removing it. It is claimed that the aerator will accomplish this. In the *Wisconsin Farmer* of Sept. 3, a short article is published on aerating milk, credited to "a Vermont authority." Says the writer, "by aerating milk, odors can be completely driven out that have been absorbed by the milk after being drawn from the cow. Odors that were derived by the milk through the system of the cow are not so easily taken out. They will be somewhat lessened, but can never be wholly removed. Milk should be aerated as soon as possible after it is drawn, and it should, at the same time, be cooled. Aerating alone is an advantage, but its good effects on the keeping of milk are much increased by bringing the milk down to 55° or lower. Milk should keep at least twelve hours longer for the aerating. By using a cooler and aerator faithfully it is possible to dispense with ice in selling milk under the ordinary conditions as they occur in the smaller cities; but where the milk is to be brought by train, and is 24 to 36 hours old before it is put on the milk cart, it would be necessary to use ice even with aerated milk. . . . The man who is raising his cream by shallow setting or cold deep setting has no use for a milk aerator or a milk cooler. Either would be a positive detriment, occasioning the loss of a large amount of butter in the skim-milk."

This subject is one of considerable interest and importance. A person has no business to have milk so contaminated by odors *after being drawn*, as to require the use of aeration to make it palatable. As bearing on the other points in the article quoted, I believe there is but little experimental evidence at hand, though this in a measure substantiates it. Our experiment stations have an opportunity to do some interesting work in this direction.

Purdue University Agricultural Experiment Station, Lafayette, Indiana.

REPORT OF THE SUMMER SCHOOL OF THE BROOKLYN INSTITUTE FOR THE SEASON JUST CLOSED.

BY HERBERT W. CONN, DIRECTOR.

THE Biological Laboratory of the Brooklyn Institute of Arts and Sciences has just closed its third season of biological work. The session has been the most successful one in its history, and as a preliminary report of the summer's work it will be fitting to give a brief account of the history of the Laboratory, together with its purposes and aims, in order that those interested in the matter may gain a better knowledge of the school.

The Biological Laboratory at Cold Spring Harbor was organized in 1890. It owed its inception to the Brooklyn Institute, and has been established as a branch of that institution of popular education. The foundation of the school was made possible through the generosity of Mr. John D. Jones and the New York Fish Commission. Mr. Jones at the outset contributed a considerable sum of money towards purchasing the equipment of the Laboratory, and the New York Fish Commission offered to the school the use of its buildings and appurtenances located at Cold Spring Harbor, L I. Other friends, among whom may be mentioned Mr. Eugene G. Blackford, Professor Franklin W. Hooper, Dr. Oliver L. Jones, Mr. Louis C. Tiffany, Mrs. H. G. DeForest, and Miss Julia B. DeForrest, have contributed generously toward the equipment and support of the school. By means of these contributions and from students' fees the Laboratory has been thus far supported. Up to the present time the hatchery of the New York Fish Commission has served as a laboratory building, but the school has reached the limit of the accommodations thus offered, and is hoping to erect a special laboratory building during the coming year, which will be especially adapted to biological work. The Laboratory has been supplied with a launch, collecting apparatus, aquaria, and other appliances necessary for the pursuit of biological work. A library of biological literature has been furnished, and microscopes, etc., have been loaned by the Brooklyn Institute and Wesleyan University. During the present year a beautiful lecture-room has been fitted up for the school by the Wauwepec Society, a society organized by Mr. John D. Jones for local improvement at Cold Spring Harbor. The New York Fish Commission has given the use of its boats, aquaria, pumps, and other apparatus, which has been of great value to the school. Thus equipped, the school has been enabled to enjoy three successful seasons, and to demonstrate the need of further support and better equipment. The Wauwepec Society is contemplating the erection of a laboratory building for its use, and its further growth is only a matter of time.

During its three years of existence, over sixty persons have made use of the advantages offered by the Laboratory, either in study or in investigation. Those attending the Laboratory have included college professors, public-school teachers, physicians, and students of various grades of schools.

The Laboratory was, for the first year, under the direction of Bashford Dean, Ph.D., of Columbia College. During the last two years it has been directed by Professor Herbert W. Conn, Ph.D., of Wesleyan University, who has been assisted by Professor Charles W. Hargitt, Ph.D., of Syracuse University, and Professor H. L. Osborn, of Hamline University. In addition to these, there have been at the school leading biologists from various institutions, including Columbia College, Rutgers College, Trinity College

University of Notre Dame, and others, who have assisted materially, to the advantage of the school, by numerous lectures, given partly to the students alone and partly to public audiences.

The need of a summer school of biology in the vicinity of New York and Brooklyn has been felt for some time. There are many teachers and students who are on the look-out for methods of passing the summer vacation, which will be at the same time pleasant and profitable. To those interested in natural history science, a summer laboratory of biology offers such an opportunity. The success of the Biological Laboratory at Wood's Holl, and the increasing demand upon its space, have demonstrated the need of other schools of similar character. Moreover, the purpose of the Wood's Holl school of attracting biological investigators, has pointed out the need of a special school of instruction. The Biological Laboratory at Cold Spring Harbor has therefore been designed to fill a somewhat different need than that of the Wood's Holl Station. It is designed primarily as a school of instruction in zoölogy and botany, and not as a special laboratory for investigation, or as a technical school, and is also intended for students rather than for investigators.

Students of biology who make use of our marine laboratories, may be divided into three classes: 1. General students, who, having little or no experience with living animals and plants, desire a general course in zoölogy and botany. This class would include medical students, who find biological study of great value as bearing upon the study of medicine, and who find no time for such work during the school year. 2. College students and others, who, having had a general course in zoölogy and botany, desire to do miscellaneous work of a higher character, or to study embryology from the practical side. 3. Those who desire to undertake original research, either independently or with special guidance. Most of the marine laboratories on our coast have been designed primarily for the third class, although other students are welcomed in some of them.

It has been the design of the school at Cold Spring Harbor to plan its course especially for the first two classes. Every year is seeing a growing demand for the teaching of natural history in our public schools, and the teacher who is in especial demand is the one who has had practical knowledge of his subjects rather than simple book-knowledge. The need of summer schools, where our teachers can gain this familiarity with nature, and at the same time pass a pleasant vacation, is becoming more and more felt. The increasing popularity of summer schools voices this demand. The public-school teacher, who wishes to take a prominent part in the better type of teaching which is rapidly forcing its way into our schools, is beginning to feel the need of practical work; and a few years hence those teachers who have made use of summer schools of practical experiment will be found holding the best positions. The school at Cold Spring Harbor has been designed primarily to meet this demand, and it purposes to offer to all wishing to take good positions in our schools a chance to so familiarize themselves with living things as to make their teaching active and vital instead of mere text-book instruction.

For this purpose an elementary course in zoölogy is arranged, lasting six weeks. During the present summer this course has been given by Professors Herbert W. Conn, Charles W. Hargitt, and H. L. Osborn. It has consisted of daily lectures describing animal types and giving information in regard to different zoölogical topics. The lectures have been followed by laboratory work upon the types described, either by microscopic study or with dissecting instruments. The practical laboratory work is personally directed by the instructor in charge. The course of six weeks thus directed gives a survey of all of the chief types of animals, and, when accompanied by collecting and by such other miscellaneous study as is sure to be suggested by the exigencies of collecting excursions, gives the student a practical knowledge of animals and life which he could not get by a much longer course of study away from the sea-shore. The general course thus given is an elementary one, but at the same time many advanced students find it worth while to follow the course partly as a review, but more especially as a means of studying fresh specimens of types which are familiar to them only from text-book descriptions. Either the whole or parts of this course are, therefore, taken by nearly all the students in the Laboratory.

To add to the value of the Laboratory in general instruction, a course of scientific lectures is given during the summer by well-known scientists from various institutions of learning. These are given in a lecture-hall near the Laboratory and are illustrated by lantern views. During the present summer there have been fifteen lectures in this course upon various subjects connected with geology, zoölogy, and botany. The lecturers have been Professor Herbert W. Conn, Ph.D., Professor Charles W. Hargitt, Professor H. L Osborn, Professor Henry F. Osborn of Columbia College, Dr. Thomas Morong of Columbia College, Professor Franklin W. Hooper of Brooklyn Institute, and Professors John B. Smith, Byron D. Halstead, and Julius Nelson of Rutgers College. These lectures, though of a high order, are not technical, and are enjoyed by all the students. It is expected next year to add a course in botany of a somewhat similar nature to that in zoölogy for the benefit of those desiring summer work in this subject.

For students who have taken the elementary course or its equivalent and desire more advanced work, no definite line of instruction is laid out, but each student's work is planned for himself. It may be that he wishes to study embryology; he is then set at work upon the development of some animal, and shown how to study its various stages and interpret their meaning, and taught how to preserve specimens for future study. It may be some special group of animals which he desires to study; then the collecting apparatus is put into use to provide him with as large a variety of the group in question as is furnished by the region. It may be microscopic anatomy that he desires; then he is given practical instruction in tissue preservation, section cutting, and staining. But, whatever the line of work such student may choose, it may be independently planned for him, and its chief aim must be in all cases to teach methods of work. For college students who have studied under constant minute direction, this somewhat greater freedom of work with living specimens, rapidly developes independence of thought and accuracy of observation, and is of the utmost value as training for future work.

A special line of work in bacteriological methods has been offered during the last two years. This line of work has no special relation to a marine laboratory, but there are many students, especially among medical schools, who desire to learn methods of bacteriological work, and find no time for it in their regular course. For this purpose practical instruction in making culture fluids and cultures, in separating and determining species of bacteria, is given. A course of twelve lectures upon the history of bacteriology has been given by Professor Conn, during the present summer. The lectures were delivered before the whole Laboratory, and those who wished have taken the practical work of making cultures and the study of the bacteria in water and milk, with other simple elementary bacteriological problems.

Thus it will be seen that the school at Cold Spring Harbor is especially intended for those desiring instruction and facilities for acquiring practical knowledge of biology. But its plans do not end here. Hitherto it has not been able to offer special inducements to those desiring to undertake original research; yet several investigators have been engaged in such work during the last two summers, and it is the design of the management to offer such opportunities as fast as facilities admit and occasion demands. The new Laboratory in contemplation will contain private rooms for research, and will be especially fitted up with reference to this work. Every endeavor will be made to meet the needs of those who desire to use the Laboratory as a place of research. The Laboratory aims first, however, at being an institution of biological instruction and to allow other lines of work to grow as occasion demands.

The session of the Laboratory lasts eight weeks, during the months of July and August. The regular course of lectures occupies the first six weeks, the last two weeks being reserved for reviews and special independent work by the students. The tuition fee for the general course is $20; for the whole session, $25. Board is furnished at $5 per week and rooms can be obtained at a

price varying from $1.50 to $4 per week. The Laboratory is open to both ladies and gentlemen.

Cold Spring Harbor is only about an hour's ride from New York, and is in itself a delightful place to spend the summer. It offers opportunities for bathing, boating, and fishing, and a visitor is never at a loss for some pleasant employment. The New York Fish Commission has one of its hatching stations here, and much of interest and profit accrues to the members of the Laboratory from the study of the specimens in the hatchery. Information as to methods of fish-hatching and fish-culture is to be had simply for the asking; for the staff at the hatchery are on the best of terms with the members of the biological school, and are willing to accommodate them in every way.

In short, the school at Cold Spring Harbor proposes to offer to all interested in biology a method for spending the summer vacation pleasantly and at the same time profitably. Many are inclined to think the summer vacation of our colleges too long; but it is not so to one who attends such a school, for here he gains both recreation and profit. The Laboratory offers him a chance for acquainting himself with living nature and the living principles of biological science. If he is already an advanced student he is offered chances for special work in the line of topics of his own choosing. If he is a teacher, he can get practical experience with animals and plants, and can make collections for his classes; and for the college professor the recreation of the holiday is combined with facilities for research along lines of biological investigation.

Last, but not least, to all is offered opportunity for personal association with educators and original thinkers in lines of science. The school has been successful thus far, and its future promises greater growth and wider influence.

ON SOME HABITS OF AMPHIUMA MEANS.

BY CHARLES W. HARGITT, SYRACUSE UNIVERSITY.

THROUGH the kindness of Professor H. J. Clements, M.D., of New Orleans, I had sent to me from the Louisiana swamps a half-dozen of the so-called "Congo snakes" early last spring. Two of them were adults of from twenty to thirty inches in length, the others being young ones not exceeding twelve inches from "tip to tip." They were shipped in damp gray "moss," Tillandsia usneides, and with a single exception all came through alive and in good condition.

They were, for want of better quarters, placed in an aquarium in which were a number of fresh-water clams (Unio). At first they were quite sluggish and seemed not at all disposed to be "at home" in their new surroundings. This was especially true of the adult. Gradually, however, the young "Congos" began to show signs of interest and appetite. I found an empty clam-shell one morning in the aquarium, and further observation soon explained it. No sooner did a clam show signs of declining vitality by an unusual gaping of the shell than it would be seized by one, often indeed by two, of the amphibians, and there was seldom any release till the shell had been relieved of its occupant. The struggle which ensued when two of them would seize a single clam was exciting and amusing in the extreme. Such tugging, writhing, and twisting into perplexing coils one seldom sees, especially among members of this class.

They proved to be exceedingly voracious; and it was but a short time ere they had disposed of some two dozen clams and had shown a remarkable growth, proving the healthfulness of the diet.

This activity, however, pertained only to the young. The adult became more and more sluggish, and it became evident within a fortnight that it would not long endure the conditions. It moreover became quite ugly of disposition, and would bite savagely at anything within reach, even maiming itself. It was consequently consigned to the dissecting-table.

The clams having been disposed of by the others, they were left for a few days without food. My attention was one day attracted to the aquarium by an unusual commotion, and, to my surprise, upon examination, I found that one of the more thrifty had turned cannibal and had half swallowed one of his less vigorous fellows. He was made to disgorge by a sharp squeeze about the thoracic region, and I hoped the thing was at an end. But in less than an hour the same thing was repeated even more savagely and upon the same victim. I immediately removed both from the tank, killing the badly injured one and leaving the other by itself. Within another day the same thing had been repeated between the two remaining in the aquarian, but was discovered before it had gone so far. They were subsequently fed upon fresh meat from other sources, birds, etc., but did not seem to thrive upon it, finally refusing to take it. They would take earthworms, but showed no disposition to take insect food. One of the number still lives in the same aquarium, and seems fairly at home, so long as fed satisfactorily. It has gone for some time without food with apparently no discomfort. These notes may add something to our knowledge of their probable mode of life. That they are carnivorous is quite certain. At no time did they show any disposition to touch vegetation, though a variety was growing at hand. That under certain circumstances they, with others of their class, will turn cannibal, is also quite certain. I have known the common bull-frog, Rana catesbiana, to devour no less than a half-dozen fair-sized leopard frogs, Rana virescens, within as many days. The same disposition has been noted among the members of other genera. It is less common, indeed rare, between members of the same species and approximately the same size, as was the case under consideration.

NOTES AND NEWS.

BULLETIN 41 of the Purdue University Agricultural Experiment Station contains information of interest and importance concerning wheat as grown in Indiana. The following are some of the points of importance, as given in the Bulletin: 1. Velvet chaff, Michigan amber, and Fultz varieties of wheat have been grown for nine years on the university farm, and rank in value as named, though Michigan amber surpasses Velvet chaff as a rust-resisting variety. 2. Red Clawson and Jones's winter fife are the two most promising recently introduced varieties. 3. For eight years, six pecks of seed sown per acre have given the most satisfactory results. 4. In the region of Lafayette, a higher average yield has been secured from wheat sown Sept. 20 over other dates of sowing. 5. Judicious rotations, including grass, have given better return than constant grain-cropping. 6. Heavy applications of manure and fertilizers to a worn soil growing corn and wheat alternately have given paying returns. 7. The average results of all the experiments at this station with fertilizers and manures upon wheat during the past three years, in full or two-thirds doses, have not been profitable. 8. The use of hot water or copper sulphate failed to destroy the spores of loose smut. 9. Bunt, or stinking-smut, in wheat was successfully destroyed by using hot water or copper sulphate. 10. Early and late harvesting of wheat had practically no effect on yield or weight of grain. 11. Yield of grain and straw were considerably reduced by mowing wheat on certain plats in spring to check rankness of growth. 12. In comparing forms of nitrogen for fertilizing the wheat plant, sulphate of ammonia gave rather better yield than nitrate of soda or dried blood. 13. As the plants fertilized with nitrate were slower to mature than the others, these also suffered more from rust than did the others. Persons interested in a more complete account of these wheat experiments, or who wish the publications of the station, can secure free copies of the same by addressing C. S. Plumb, director of Experiment Station, Lafayette, Ind.

— *The Illustrated American*, which has achieved great popularity as the handsomest illustrated weekly published in our country, has been reduced in price from twenty-five to ten cents. This reduction has been brought about by improvements in its engraving and printing establishment, and, it is claimed, will in no way affect its literary and artistic excellence. This change places within the reach of all a most excellent periodical.

— Harvard University is about to publish a reprint of certain important "State Papers and Speeches on the Tariff," by Hamilton, Gallatin, Webster, and other statesmen, with an introduction by Professor F. W. Taussig.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

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A LABORATORY FOR PHOTOGRAPHIC RESEARCH.

BY ROMYN HITCHCOCK.

THE discussion upon the respective merits of ordinary and color-sensitive plates for photographing stars, which has been raised by the French astronomers, is only a single example out of a great number which might be mentioned to show how much experimental work has yet to be done before our photographic processes will fully meet the demands of scientific investigation. Modern photography has experienced very rapid development. It has been such a fascinating subject for experimentation that a great host of workers, many of them skilful and indefatigable, have contributed a countless array of facts, but intermingled with these are so many observations of a different character that the extensive literature of the subject is very confusing. What, for instance, are we to understand concerning the remarkable phenomena observed by several of the early investigators who found that certain rays of the spectrum produced chemical changes which were reversed by certain other rays? It has seemed to me that this subject would well repay investigation with the improved appliances and better knowledge of the present time. The latest application of the phenomenon that has come to my notice has been at the astro-physical observatory at Washington, in an attempt to photograph the invisible infra-red spectrum by means of a phosphorescent plate. The rays of the spectrum destroy the phosphorescence, leaving luminous bands representing the spectrum lines. It is not probable that any such method will prove of much practical value, but none the less is the investigation of the phenomenon to be advocated for the information to which it may lead concerning the nature of radiant energy.

The fact that Professor Langley has resorted to such a device to photograph the invisible part of the spectrum brings clearly before us the supposed limitations of photography in this direction. The limits of the photographed spectrum have within a few years been greatly extended into the red, and even beyond it perhaps, by special sensitizing agents or by peculiar methods of preparing plates. But the theory of the subject has not been worked out, and in this there is a very important field for research. The inducements to carry out such investigations must come from those who most need the results. In other words, here as in other cases the photographic investigator would like to know that his results will be intelligently applied, else he becomes discouraged and enters upon some other field. If the physical observer would encourage research in photography to meet his requirements, and if the astronomer would have plates perfectly adapted to his purpose, let them cease to place their reliance upon color-sensitive plates, or on any other plates prepared for the public demand, and put their photographic work in the hands of an experienced photographic chemist — not a mere operator picked up in a gallery or among amateur experimenters — but one who can apply the latest discoveries to the work in hand. It is because investigators who are not trained photographers, familiar with the processes and discoveries of the time, have undertaken to do the most difficult kind of photographic work themselves, that the results are so frequently inferior to what they might be. It is certainly a fact that the best photographic knowledge we possess is not generally applied to scientific work.

It is upon such grounds as these that I have long advocated the establishment of a photographic laboratory for research in connection with one of our great institutions. Such a laboratory would not only lead to important discoveries and improved methods, but it would give an impetus to the study of photography as a science involving chemistry and physics, in preparation for work in various branches of science. The problems presented in the observatory and in the spectroscopic laboratory could then be systematically studied, as they cannot be by the workers in these different fields. For example, the astronomer desires plates for photographic star-maps, which shall be uniform in character and rapidity, unaffected by temperature or moisture, free from granularity and without the tendency to "halation" by long exposures. More than this, an effort should be made to produce a plate which will reproduce fairly well the relative actinic magnitudes, if I may coin the expression, if not the visible magnitudes of stars. That such plates can be produced scarcely admits of a doubt, but to establish the fact requires some, perhaps a great deal of experimenting. But having once accomplished the result, it would be a boon to astronomy sufficient in itself to justify the existence and liberal endowment of such a laboratory. The mere discovery of a means to produce plates of absolutely uniform sensitiveness, measured in units of time and also spectrographically, would be of incalculable benefit to physical investigation. As regards the granularity of the image, it has been clearly demonstrated that this is greatly influenced by the development, particularly with certain plates more than others.

Now as regards plates for other special purposes, to mention a case in point, I refer once more to Professor Langley's desire to photograph the part of the spectrum which he has so ingeniously mapped with the bolometer. No one has questioned the accuracy of the indications of that instrument, but it would certainly be of interest to see a photographic reproduction of at least a portion of that invisible spectrum, to compare it with the bolometric curves. It would enable us to interpret the latter with much more confidence when it becomes desirable to reduce the curves to spectrum lines.

As already stated, considerable work has been done abroad in extending the photographic action of the red rays of the spectrum. Schumann, for example, has photographed the spectrum, showing line *A* distinctly and for some distance beyond.

But when we consider the enormous extension of the invisible spectrum beyond the blue, recently photographed by Mr. Schumann,[1] on plates especially prepared for the purpose, we have an indication of the possibilities of scientific research in photography. There is really no reason to suppose that we have reached the photographic limit in the less refrangible end of the spectrum.

The interesting phenomenon of the sun's corona has led to many attempts to photograph it on the rare occasions offered by total solar eclipses. But so little have the photographic conditions been considered in this connection, that, as I have elsewhere remarked, the government photographic expedition was sent to Japan without a photographer, and the expedition to Africa went with commercial color-sensitized plates. Now, it would be interesting to learn the reason for the selection of those particular plates for the corona. While I am not prepared to say that they

[1] Hitchcock, R. The latest advances in spectrum photography, *Science*, Feb. 26, 1892.

were not wisely chosen, the facts in the case not being before me, I am free to confess that I have grave doubts whether they were even as well adapted to the purpose as the ordinary dry plates. In any case, the best work on the corona has yet to be done, with plates prepared for that special purpose, and with apparatus specially arranged. Several efforts have been made in this direction abroad, not with entire satisfaction it is true, but they indicate a recognition of progress in photographic work, and a laudable disposition to apply the latest knowledge to special requirements. I am not aware that any photographic experiments are now under way in anticipation of improved methods to be applied to the solar eclipse next year. If not, we have no reason for expecting any better photographs of the corona than those of Professor Holden, which are doubtless as good as can be made without special plates. Let me add as a purely gratuitous opinion, founded, however, upon long consideration of the subject, that I am convinced of the practicability of photographing the corona without waiting for an eclipse. To do this, however, would require no small amount of preliminary work, for which a well-equipped laboratory is necessary.

Not wishing to extend this communication to undue length, I confine my remarks to these few eminently practical subjects for laboratory research, only adding that there are many others which deserve investigation, such as photographic standards of light and color, methods of recording daily solar activity, the comparison of the chemical and visual effect of light of various colors,—a very important subject in stellar photography,— atmospheric absorption, the application of photography to meteorology, the formation of clouds, lightning, and a host of other subjects which will suggest themselves.

The point I wish specially to make is that a photographic research laboratory would be of the greatest value as an aid to research in many branches of physical investigation. It has been my privilege to visit the laboratories of Dr. Eder in Vienna and Dr. Vogel in Berlin, both of which have contributed so much to a practical and scientific knowledge of photographic methods; but above either of these, for purely scientific research, I should say the private laboratory of Mr. Schumann, in Leipzig, although much more restricted in scope, approaches nearer to my ideal of what we most need in this country.

I trust that these few words will receive such favorable consideration and support from the scientific men of the country — especially from those who have experienced the shortcomings of photography in recording the results of their work — as they may seem to deserve, and that a laboratory such as I have indicated may soon be established either in connection with one of our large universities or by private endowment.

The Woodmont, Washington, D. C., Sept. 9.

THE RETICULATED PROTOPLASM OF PELOMYXA.

BY DR. ALFRED C. STOKES.

WITHIN recent years the structure of protoplasm has been much studied by microscopists, and the several theories enunciated have attracted considerable attention and been the subject of considerable discussion. The entire subject is a fascinating one, but among all the doctrines put forth by various observers, either as the result of personal investigations with modern high-power objectives, or as a result of a working of the "scientific imagination," none has received more attention of a certain kind, and none is more pleasing, than Dr. Carl Heitzmann's theory of the reticulation of the protoplasm. Yet simple and beautiful as his doctrine is, it has been ridiculed and summarily dismissed by those that have failed to obtain results similar to his.

Dr. Heitzmann claims that all animal protoplasm is at all times a net-work of delicate threads, in which is the life of the object, the meshes thus formed containing the liquid or semi-liquid and other non-living constituent parts of the protoplasm. His book on the "Microscopical Morphology of the Animal Body in Health and Disease" is somewhat surprising, since he sees all tissues as formed of reticulated protoplasm, an appearance that he seems to have no difficulty in demonstrating, but which the majority of microscopists and histologists claim to be unable to see, and which they say is therefore non-existent. The subject merits further attention. Judging from a limited experience, but from an experience gained through an eye to a certain extent trained in microscopical examination with high powers, I am willing to confess that the Heitzmann doctrine of the structure of protoplasm is more than satisfying; if it should be proved to be illusory or the result of the action of reagents, I should be disposed to abandon it with regret.

In 1873, Dr. Heitzmann, before the Vienna Academy, demonstrated the reticular structure of the protoplasm of the common *Amœba*, a microscopic animal within reach of every microscopist, and one in which the reticulation should be readily seen with the proper optical appliances, if it exist. I do not know that any effort has ever been made in this country to repeat this observation in order to refute or to confirm it. The white corpuscles of human blood are conspicuously reticulated after treatment with certain reagents, and if the common *Amœba* should present a somewhat similar structure without having been subjected to the action of a chemical solution, the fact would be of great importance and interest. It would seem, too, that microscopists are not living up to their privileges if they fail to heed a suggestion that may be of so great importance. Yet so far as any prominent printed record appears, the common *Amœba* has never been examined with modern high-power objectives by competent microscopists having this object in view. If such papers have been published, they have not come to my notice. I am not claiming any merit on my own part, for I am also one of those that have given no attention to this attractive subject. I have never submitted the *Amœba* to the tests needed to demonstrate, for my own personal satisfaction if for no other reason, whether or not the reticulum exists in its protoplasm as Dr. Heitzmann says it exists. But that at certain times in certain places within all animal bodies the structure of protoplasm is reticular there can be no doubt. That the reticulum exists at all times and in all places is another matter.

But recently, while I was making a microscopical examination of a sample of urine, a single scale of epithelium appeared under the objective in a drop of the fluid, and was as perfectly and superbly reticulated as could be desired by the most ardent advocate of the theory. The cell had had no treatment except what may have come from its soaking in the urine, yet the net-work of its protoplasm was perfection, and its prominence must have forced itself upon the attention of any microscopist. But thousands of epithelial scales may be studied in as many samples of urine, and not another found in this beautiful condition.

In reference to the common *Amœba*, although I have never yet studied it with the reticulation of its protoplasm in mind, I have recently had the satisfaction of examining a favorable specimen of the allied *Pelomyxa villosa* Leidy, in whose ectosarc the reticulum of the protoplasm was as perfect and as conspicuously marked as in the single epithelial scale just mentioned. *Pelomyxa* is a common Rhizopod in this locality (Trenton, N. J.), but it is usually so gorged with food, with sand grains or with other opaque particles, that its body is almost black by transmitted light, and therefore unsuited for such a purpose as a search for protoplasmic reticulations. But this particular individual was without these obscuring elements, being almost transparent, and fortunately with the protoplasm of the ectosarc so conspicuously reticulated as to obtrude itself upon the microscopist's notice. If the softer and continuously flowing endosarc had been surrounded or enclosed within a delicate net of cords, the reticulations could not have been more apparent or more distinct, becoming even more conspicuous when this external coating flowed out to cover a newly produced pseudopodium. The meshes of this beautiful net were angular, and the living threads that formed them were rather actively contractile, the meshes becoming narrowed and elongated during the animal's movements of progression. The greatest length of perhaps the largest space was, during quiescence, about one six-thousandth of an inch, the smallest being probably about one-third of that size, although careful measurements were not made of either of these.

There can be no doubt that at least at times the ectosarc of *Pelomyxa villosa* is formed of reticulated protoplasm. That it is

always so constituted further investigation should determine. As it is comparatively immense, its examination is not so difficult as is that of the smaller *Amœba*, the study of which, with this special object in view, would demand greater care and an eye trained by practice over the microscopically minute. The subject and the facts are important by reason of their bearings upon the minute examination of objects that may, perhaps, possess a more utilitarian purpose than either the common *Amœba* or the almost equally common *Pelomyxa*.

The examination in this case was made with Bausch & Lomb's homogeneous immersion one-eighth, Reichert's oil-immersion one-twelfth, N. A. 1.40, and Gundlach's homogeneous-immersion one-twentieth, N. A. 1.20.

Trenton, New Jersey.

GLACIATION IN WESTERN MONTANA.

BY HERBERT. R. WOOD.

THE evidences of glaciation in western Montana are very apparent from Helena to Hope (Idaho). They are shown by a series of parallel valleys with a north and south trend, and another series of rounded oblong isolated valleys, connected by narrow necks of land along river bottoms between mountain chains. The former follows the strike of the rocks, occurring along contact lines, synclinal folds, shore or marginal beds of the Sub-Carboniferous formations; the others cross the strike, and, like the former, are also largely the result of pre-glacial denuding forces. The direct evidences are erratic blocks, terminal moraines (frequently holding back lakes), clays, striæ, gravels, etc. The main range of the Rockies (5,550 feet, at Mullan, above the sea), consisting of Devonian, Carboniferous and Sub-Carboniferous, has a valley on the west in the upper Cambrian. Further north west the glacial striæ run 45° north of west, the general course of valley being 30° north of west.

The elevation at the boundary here is 4,000 feet above the sea; 100 miles south of this it is 3,200 feet, in vicinity of Missoula. From the summit of the main range, as given above, to Hope, Idaho, 300 miles, the fall is over 3,000 feet (5,550 — 2,200). The fall from the boundary is not constant; at Libby, near Idaho, the height is 2,000 feet, forty miles south of this it is 2,500 feet. While the glacial action has been generally from the north, at 100 or 150 miles from the boundary seems to have been the end of the terminal moraines; and a series of glaciers came from the south — the higher elevations of the Bitter Root Range. The great Flathead Valley, which lies west of 114° and extends south from the boundary for 150 miles to Ravalli, is about 30 miles wide. In its southern portion a lake is situated, which is about 35 miles long, dammed by a terminal moraine 200 feet high. The lake is 1,000 feet in depth, its northern shore being a plain, extending for 30 miles, representing an old lake-bed. Another moraine extends across the northern part of this plain, making the boundary line of its northern shore. Such a glacier that could produce this excavation must have been 2,000 feet in thickness and 25 miles wide. Heavy beds of clays, 150 feet in thickness, cover the plain, with a few boulders and thin beds of sand in its lower layers, which is followed by gravels. The worn-down roots of a mountain range are noticeable at both the north and south shores of the lake. This valley runs along the shore line of the lower Cambrian quartzitic series. Some glaciated valleys enter this from the west. The direction of this great glacier seems to have been south-east, crossing a range of mountains 20 miles to the east, which it has left hummocky and worn. Ninety-eight miles west of this the Cabinet Range, 30 to 40 miles long, 7,000 to 10,000 feet high, on the borders of Idaho, shows marked glaciation, the striæ having a course 42° south of west. The height, at Libby on Kooterian, above the sea here is 2,000 feet. The glacial detritus piled along the flanks of this anticlinal is 700 feet in thickness, and represents the material from the gulches. At Hope Pend O'reille Lake the glacial action has undoubtedly been very great, the lake being 2,000 feet deep, with a mountain 4,000 feet above the sea to the north of it. The town is 2,000 above the sea. A number of islands in the lake are scoured down to the water's edge. They represent mountains which may have risen as high as that mentioned. The striations are 40° west of north, 42° west of north. A terminal moraine has dammed the river (Clark's Fork of the Columbia), which enters it from the east, and turned it a mile to the south. Pre-glacial action has been active here and at Libby (see above), some 6,000 feet of strata having been removed from the summit of the Cabinet anticlinal, most of it being pre-glacial denudation. Lake Pend O'reille may perhaps fitly be a glacial lake, a rock basin, which has been filled by the waters of the Columbia. The greatest length of the lake is along the strike of the rocks, though this has not been an important feature in moulding its form, but rather the action of glacier, boulders of diabase and granite being observed several hundred feet above the lake along the mountain side. At Clark's Fork, 20 miles east, I observed granite boulders, on a mountain, at a height of 1,800 feet, or about 4,000 feet above the sea. Heavy beds of gravels, clays, and boulders fall on the valley of the river (Columbia) for 60 miles, the general direction being east and west. At Thompson the glacier has scoured down a range to the south, the path of the glacier being here apparently south-west. A series of terraces extend along the north side of the river, with large blocks of slates (presumably of pre-Cambrian age). At Horse Plains a small valley running east and west represents an old post-glacial lake-bed. The glaciers here came from the north, piling up heaps of clays and gravels along the north hummocky side of the valley. One large erratic block of limestone (upper Cambrian) measured 12 x 15 x 18 feet. It was perched about 400 feet above the valley on a diabase dike. This point is 75 miles west of Missoula and about 2,460 feet above the sea. At Missoula a large gravel plain (an old lake-bed), of 40 or 50 miles square, lies in the midst of the lower-Cambrian rocks. To the north the cretaceous rocks dip into the mountains eight miles distant at an angle of 30° north-west. The glaciers have greatly denuded this cretaceous belt into low foot-hills in their path from the mountains (8,000 feet above the sea) 8 or 10 miles north. Moraines flank the mountains, large blocks of slates and quartzites from the Cambrian rocks resting at the mouths of creeks and stretching across the old lake-beds. Around the mountains a series of beaches or beach-lines extend; I have counted 26 of them one above the other, extending upward for nearly 2,000 feet above the plain. These beach-lines I have traced for 50 miles. They seem to represent a pretty general upheaval following upon the close of the cretaceous period. The depth of the gravels which form the old lake-bottoms must be very great. They consist of Cambrian quartzites. To the south of Missoula extends a long valley (terraced) for 75 miles. It lies to the east of a gneissoid range or a bedded quartz porphyry porphroidal or gneiss coeval with Pilot Knob of Missouri and the older Archean gneisses. A glacier undoubtedly travelled to the north, cutting out a range of Cambrian rocks, dipping south, nine miles south of Missoula, connecting it with the old lake previously mentioned. To the north-west of Missoula are several small valleys, through which the Blackfoot River runs. They all run east and west or nearly so across the strike of the rocks, and are divided by low, rounded, hummocky ranges, over which the glaciers have passed. Stratified gravel deposits are exposed along river banks, 75 feet in thickness. One valley, about 12 miles long, running along the strike of the rocks, which dip east, has a moraine at its northerly end made of thickly scattered angular boulders and clays, and of a terrace-like nature, rising 200 feet above the river, which has here cut through it. Ten miles further north another moraine occurs, and five miles further north a great moraine of several hundred feet in thickness and holding ponds and small lakes in its surface. These seem to show, so far as a hasty examination would permit, points in the recession of a great glacier whose course was south-west. A few generalizations from these facts show pretty conclusively that,

1. The rivers are nearly all of pre-glacial origin, but probably post-cretaceous, one or two having been deflected in their courses by the glaciers.

2. The denudation has been largely, if not in greater part, pre-glacial.

3. No apparent upheaval has occurred since the glacial period, but a series of beach-lines indicate a pretty general elevation following the cretaceous period.

4. The general trend has been south, south-east, and south-west, but frequently deflected east and west by ranges and pre-existing valleys. The great Flathead glacier west of 114° shows a length of 150 miles from boundary. Along a line 150 miles south of boundary, which rapidly swings to the north as we go westward, the lower limits (moraines) of this series of glaciers is evident. To the south of these the glaciers have had a northerly trend, forming a series of valleys running north and south. Short glaciers, radiating from local heights, as at Libby, and Missoula and various other places, were common. Some of these have no doubt been persistent for some time since the glacial period proper.

5. With the recession of the glaciers the lakes were drained to the west.

6. Existing glacial lakes are four or five in number. They are rock-basins eroded no doubt greatly before the glacial period. In nearly all cases they are dammed by terminal moraines.

7. The area touched upon is 300 miles (E. and W.) by 100–150 miles (N. and S.). The fall being to the west and south as noted; on the map it may be found from the 49th parallel on the north to the 47th on the south, from the Rockies (main range on east) to Idaho boundary-line.

8. Terraced valleys of much interest occur, but to which no detailed study has been given.

THE SHRINKAGE OF LEAVES.

BY E. E. BOGUE.

PROBABLY every maker of botanical specimens has observed that the leaves when dry are smaller than when fresh. The wish to know how much the shrinkage might be led to the following measurements. The leaves were measured before they had wilted, and after they were perfectly dry.

The longest dimensions were taken in each case. The width or dimension across the midrib is first given in each case; the first column shows the measurements when fresh, and the second column the measurements when dry. All measurements are given in inches and parts of an inch.

Scarlet Oak (Quercus coccinea).

Fresh.	Dry.
$7\frac{5}{8} \times 12\frac{3}{4}$	$7\frac{5}{16} \times 12\frac{5}{16}$
$6\frac{3}{8} \times 11\frac{1}{2}$	$6 \times 11\frac{3}{8}$
$6\frac{7}{8} \times 12\frac{3}{4}$	$6\frac{9}{16} \times 12\frac{7}{16}$
$6\frac{1}{4} \times 12$	$6\frac{1}{8} \times 11\frac{13}{16}$

Arisæma triphyllum (Indian Turnip).

$4\frac{13}{16} \times 9$	$4\frac{5}{8} \times 9$
$5\frac{1}{4} \times 8\frac{5}{8}$	$5\frac{1}{4} \times 8\frac{5}{16}$
$4\frac{1}{2} \times 7\frac{5}{8}$	$4\frac{1}{2} \times 7\frac{1}{2}$
$4\frac{5}{8} \times 7\frac{3}{16}$	$4\frac{11}{16} \times 7\frac{1}{8}$
$5\frac{3}{16} \times 7\frac{1}{2}$	$5\frac{1}{8} \times 7\frac{1}{2}$

Asimina triloba (Common Papaw).

$4\frac{7}{8} \times 12\frac{5}{8}$	$4\frac{5}{8} \times 12\frac{3}{4}$
$4\frac{7}{8} \times 13$	$4\frac{1}{2} \times 12\frac{3}{4}$
$3\frac{7}{8} \times 10\frac{7}{8}$	$3\frac{13}{16} \times 10\frac{9}{16}$
$4\frac{1}{16} \times 12$	$4 \times 11\frac{7}{8}$
$5 \times 13\frac{7}{8}$	$4\frac{7}{8} \times 13\frac{5}{8}$

Arctium Lappa (Burdock)

$9\frac{5}{8} \times 15\frac{3}{4}$	$9\frac{1}{2} \times 15\frac{5}{8}$
$11\frac{5}{16} \times 17\frac{7}{16}$	$11 \times 17\frac{1}{4}$
$9\frac{1}{2} \times 14\frac{5}{8}$	$8\frac{7}{8} \times 14\frac{7}{16}$

Asclepias cornuti (Milkweed).

$4\frac{1}{4} \times 7\frac{15}{16}$	$4\frac{1}{16} \times 7\frac{13}{16}$
$4\frac{1}{4} \times 9\frac{1}{4}$	$4\frac{1}{16} \times 9$
$4\frac{1}{2} \times 9\frac{3}{16}$	$4\frac{3}{8} \times 9$
$4\frac{1}{4} \times 9\frac{1}{16}$	$3\frac{15}{16} \times 8\frac{7}{8}$
$3\frac{13}{16} \times 8$	$3\frac{11}{16} \times 7\frac{3}{4}$

Acer saccharinum var. nigrum (Sugar Maple).

$5\frac{7}{8} \times 5\frac{1}{16}$	$5\frac{3}{4} \times 5$
$6\frac{11}{16} \times 5\frac{7}{8}$	$6\frac{5}{8} \times 5\frac{13}{16}$
$7\frac{7}{8} \times 5\frac{7}{16}$	$7\frac{3}{4} \times 5\frac{3}{8}$
$7\frac{5}{8} \times 5\frac{7}{8}$	$7\frac{1}{4} \times 5\frac{13}{16}$
$6\frac{7}{16} \times 5\frac{1}{2}$	$6\frac{3}{8} \times 5\frac{1}{2}$

Abutilon avicennæ (Velvet-Leaf).

$8\frac{5}{16} \times 8\frac{5}{16}$	$8\frac{1}{4} \times 8\frac{1}{4}$
$9 \times 9\frac{5}{8}$	$8\frac{7}{8} \times 9\frac{1}{2}$
8×8	$7\frac{7}{8} \times 7\frac{13}{16}$
$3 \times 3\frac{1}{8}$	$2\frac{1}{16} \times 3$
$9\frac{3}{16} \times 8\frac{7}{8}$	$9 \times 8\frac{3}{4}$
$9 \times 9\frac{1}{4}$	$8\frac{3}{4} \times 9$
$8\frac{1}{2} \times 8\frac{1}{2}$	$8\frac{7}{16} \times 8\frac{1}{2}$

Rumex obtusifolius (Bitter Dock).

$5 \times 11\frac{1}{4}$	$4\frac{7}{8} \times 11$
$4\frac{11}{16} \times 8\frac{1}{2}$	$4\frac{7}{16} \times 8\frac{3}{8}$

Platanus occidentalis (Sycamore).

$8\frac{1}{4} \times 6\frac{1}{2}$	$8\frac{1}{16} \times 6\frac{3}{8}$
$8\frac{7}{8} \times 7\frac{3}{8}$	$8\frac{3}{4} \times 6\frac{7}{8}$
$9\frac{1}{4} \times 6\frac{1}{2}$	$8\frac{3}{4} \times 6\frac{1}{2}$
$7\frac{3}{8} \times 6\frac{1}{16}$	$7\frac{1}{4} \times 6$

Nymphæa odorata (Sweet-scented Water-Lily).

7×7	$6\frac{1}{4} \times 6\frac{1}{4}$
$10 \times 8\frac{3}{4}$	$9 \times 8\frac{1}{4}$
$8\frac{1}{2} \times 7\frac{3}{4}$	$7\frac{1}{2} \times 7$
14×14	13×13
$11\frac{1}{4} \times 10\frac{1}{2}$	$10\frac{5}{8} \times 9\frac{11}{16}$

Nelumbo lutea (Yellow Nelumbo).

$11\frac{13}{16} \times 12\frac{1}{2}$	$11\frac{3}{8} \times 11\frac{15}{16}$
$13\frac{1}{2} \times 14\frac{5}{8}$	$13\frac{1}{4} \times 13\frac{7}{8}$
$12 \times 12\frac{1}{4}$	$11\frac{5}{8} \times 11\frac{5}{8}$
$12\frac{5}{8} \times 13\frac{5}{16}$	$12\frac{1}{2} \times 12\frac{5}{8}$
$12\frac{1}{4} \times 12\frac{1}{4}$	$11\frac{13}{16} \times 11\frac{7}{8}$
$9\frac{1}{16} \times 9\frac{1}{2}$	$9 \times 9\frac{1}{16}$

The leaves were pressed enough to keep them from wrinkling. A piece the size of a mounting-sheet ($11\frac{1}{2} \times 16\frac{1}{2}$) was cut from a leaf of the Nelumbo, and was found to decrease from that size to $11 \times 15\frac{1}{16}$. It will be seen that the least shrinkage was in the Indian turnip (the measurements here referring to leaflets), and the greatest shrinkage in the water-lily. Petioles of the sugar-maple were measured and ranged from $2\frac{3}{4}$ to $4\frac{7}{16}$ in length, but were shortened by drying, if at all, less than $\frac{1}{16}$.

It will be noticed that in the velvet leaf the small immature one decreased more even than the largest one.

Ohio State University, Sept. 10.

LETTERS TO THE EDITOR.

Pre-Aino Race in Japan.

I MUCH regret that Prosessor Morse should think that I have intentionally misrepresented or carelessly disregarded his views concerning the pre-Aino occupancy of Japan, as he rather vigorously maintains in *Science* of Sept. 9. It can scarcely be said that I have claimed for myself the discovery that there was a race of people in Japan before the Ainos. The most I have endeavored to show is the possibility,— I do not even go so far as to suggest the probability,— that the pre-Aino inhabitants of Japan may have been the people who dug the pits in Yezo.

As regards the Aino occupancy of Japan, Professor Morse will find that the "historical records" of the country, which he mentions, have not been disregarded in my article, and, in fact, the evidences of the shell heaps are, to my mind, the least convincing of any, until the fact of the Aino origin of them is established. It is the historical evidence, the distribution of geographical place-names, and, last but not least, Japanese tradition, which are at present the strongest evidences in this connection.

An author may be criticised for sins of omission, and even for

errors due to misapprehension; but to charge him with neglect and wilful misrepresentation of another's views involves a presumption of motives which, I trust, are not common among students of science. I have the highest regard for Professor Morse personally and for his valuable and painstaking work in Japan, not only upon this subject but upon others, and I certainly would not willingly misrepresent his views nor disregard them. He will no doubt have observed that this part of the subject is treated in a much briefer manner than might have seemed desirable, otherwise I do not think he would have found any cause for complaint. ROMYN HITCHCOCK.

The Woodmont, Washington, D.C., Sept. 12.

On Biological Nomenclature.

PROFESSOR UNDERWOOD'S article in *Science* for Aug. 26 calls for a general expression of views on this subject. The article above referred to was written from the standpoint of the botanist, while the present one will be perhaps more from a zoölogical standpoint. The writer, however, recognizes no distinction between the two, and firmly believes that the system of nomenclature should be absolute and uniform for all branches of biology. Absolutely the same rules should be recognized throughout the departments of botany and zoölogy, and these rules and regulations ought to be speedily decided upon by a congress of the leading biologists of the world, to which every country and organization so interested should send delegates. In the meantime every one follows his own particular ideas in regard to the matter, which may be either right or wrong.

I desire here to express my unprejudiced but very decided views on the seven questions which Professor Underwood puts, and will preface them with the remark that in no case can the name of the original erector and describer of a genus or species be separated therefrom without gross injustice.

1. Shall there be an initial date in nomenclature? Let us by all means recognize the validity of the first names proposed when accompanied by a sufficiently recognizable description and not preoccupied. In some cases, as with many of the older authors, descriptions must be recognized which would not be considered sufficient at the present day.

2. Shall names long used be laid aside when claimed for other plants [or animals] on grounds of strict priority? They should, when it is unmistakably evident that the original describer so intended.

3. Shall "the first name under a genus" hold against a previous specific name? By no means. The specific name first proposed should, coupled with the name of its original describer, follow the name of whatever genus it may be finally relegated to.

4. Shall varietal names have priority over established specific names? Yes, but with the name of the original proposer attached. I do not agree with Professor Underwood on this point, but believe that varietal names lay claim to the same priority as specific names, *when they are found to be valid.*

5. Can inappropriate names be cancelled on that ground alone? They cannot with any degree of justice.

6. How far has a later writer a right to correct names previously established? He has no right whatever to in any way change the spelling of a name from what was intended by the original describer. If by a typographical error the name was printed wrong, and the author corrects it later in print, his correction should be accepted. I am strongly in favor, however, of beginning *all* specific names with small letters, whatever their origin, and making all compound specific names into simple terms by writing them with the hyphen dropped. I would write *Brevoortia idamaia* Wood, or *donnellsmithii*, or *mariaewilsoni*, to use Professor Underwood's examples. I have no right to change the endings in any way whatsoever, neither have I the least right to supply a syllable apparently omitted, judging from the derivation. I would not consider that I had the power to elide or supply a single letter, if by such act I changed the term from what was originally proposed and intended by its describer. My conviction is that, except in manifest errors of *typography*, names should be let alone. Errors of orthography may be left to stand.

7. What credit should be given for generic and specific names? Write the name of the author of the specific name, *without* parentheses, whether there have been a dozen transfers or none at all to a new genus. There is no necessity whatever for shedding glory upon the one who made the transfer. Usually he erects a new genus to accept the transferred species, and the fact that his name will go down the corridors of time coupled to the genus he erected is glory enough. He has no right whatever to the species. Even if he does not erect the genus, he certainly has full credit in the literature for making the change, and the act does not demand recognition in the system of nomenclature itself.

I would write *Metzgeria pubescens* Schrank, to use the example given in the article referred to, and make no more ado or trouble about it. This signifies *always* that the authority named described the species originally and originally proposed that name. The founder and date of the genus can be ascertained by referring to any monograph. The generic conceptions of the original authority should not enter into consideration at all.

As to the question of "once a synonym, always a synonym," I believe in the negative. If a form, which had been described and then thought to be the same as some other species, is later proven to be a valid species, the name originally proposed should stand.

Generic names should not agree too closely in orthography. I should say that *Richardia* ought to preclude *Riccardia*; certainly *Cæsia* should preclude *Cesia*. I do not think that different derivation, or original meaning, presents any excuse for similarity of terms. The difference should be sufficient to preclude any possibility of error on the part of a student unfamiliar with both terms. I believe also that a generic term already used in botany should not be proposed in zoölogy, and *vice versa*. I would be cautious about changing those which have already been of long standing, however.

Lastly, specific names should never be capitalized or written with a hyphen; and no comma should be inserted between the specific name and its authority. It would be a great boon to biologists if absolute uniformity could be infused into the system of nomenclature. C. H. TYLER TOWNSEND.

New Mexico Agricultural College, Sept. 1.

Grand-Gulf Formation.

I HAVE read with great interest recent contributions to the literature of the Grand-Gulf formation, including Professor Hilgard's valuable paper in the *American Journal of Science* and Judge L. C. Johnson's letter in your last issue. As I have recently been summarizing our knowledge of the Post-Eocene Tertiary (to appear shortly in Bulletin 84, U. S. Geological Survey, which is already in type) I am moved to add a few words in regard to the subject for your columns, which I have already expressed in correspondence with several of those interested.

At the time of the Grand-Gulf sedimentation the lower valley of the Mississippi was already the theatre of estuarine conditions and operations, which date to a very ancient geological time. Toward the end of the Chesapeake or newer Miocene epoch this gulf extended far into the interior, its south-eastern point of entrance being somewhere in the meridian of Mobile, or between Mobile and the Appalachicola River. The embayment, which I have called the Gulf of Mississippi, received an immense drainage, corresponding to that of the whole Mississippi valley and perhaps that of the upper lakes of the present St. Lawrence system. The operations in progress consisted in the transfer of material from the elevated interior to this gulf by the medium of the drainage, and in all probability a gradual or intermittent shifting of level as weight was removed from the uplands and deposited beyond the shore-line. The shallows, as I conceive it, sank and the interior rose, thus preserving a sort of balance, and there is some reason to suppose that a specially important movement took place at the end of the Grand-Gulf epoch, by which the more energetic degradation characterizing the Lafayette epoch was inaugurated, the Strait of Georgia closed, and the previously existing islands of central Florida were joined to the mainland. I agree entirely with Hilgard's view that elevation was essential for the geological operations which are recorded in the stratigraphy of these two epochs.

The Grand-Gulf strata show gravels, sands (now frequently

converted into quartzite), and clays. They were laid down in water which was too brackish at times for the establishment of a fresh-water fauna in the estuary and too fresh for a marine fauna. In short, the conditions were those of an estuary during a period of rather rapid sedimentation. This estuary probably was, as many southern estuaries are now, defended from the sea by low bars or sand islands, on the seaward side of which a marine, probably Chesapeake, fauna flourished, whose remains are now buried 700 to 1000 feet below the level of the Gulf of Mexico. On the shores grew palmettos, and drift-wood in abundance brought down by the rivers was strewn upon them. I regard it as likely that part of the gravels bored through by artesian wells, in the axis of what was the Gulf of Mississippi, are referable to an earlier period than that of the Grand-Gulf epoch, since the same processes were at work there throughout the whole of the Miocene. Coëval with the sediments of the Grand Gulf were marine deposits along the shores of the Gulf of Mexico, both east and west of the entrance to the Gulf of Mississippi. As the erosion of the land became more complete the slope of the drainage became less, the currents slower and the sediment finer and lighter, fine sand and clay replacing the gravel and coarser material of the earlier part of the epoch. In short, the clays to which Johnson has applied the name of the Pascagoula formation, began to be laid down, the sea was less energetically pushed back by the outflowing river-waters, and the conditions became more favorable for the establishment of a brackish-water fauna.

The word formation has been used very loosely in American geological literature. In the sense in which we use the term for the Chesapeake Miocene, or the Grand Gulf, or Lafayette rocks, I conceive that these clays do not constitute a formation. They really represent for me a phase, the latest and most gentle, of the Grand Gulf, which is represented by the sands with palmetto leaves above the Chesapeake strata in the section at Alum Bluff on the Chattahoochee River. We may, slightly modifying Johnson's term, refer to them as the Pascagoula clays.

A correction is also required in the definition of these clays, or rather the fauna they contain. It is not, as supposed by Johnson, a marine fauna. All the species are or may be a part of a strictly brackish-water formation. The collections of Johnson, as well as material from the Mobile well, have been in my hands for study. The fauna comprises a large oyster, a small *Gnathodon*, which I have described under the name of *G. Johnsoni*, a small *Mactra*, also found in the Chesapeake Miocene, fragments of a *Corbicula*, and a *Hydrobia*, which I have named *H. Mobiliana*. The supposed *Venus* of which Judge Johnson speaks is the young of the *Gnathodon*. All these species are characteristic of estuaries, and will be discussed in my "Tertiary Mollusks of Florida," of which Part II. is now printing. The depth at which this fauna is encountered in the Mobile well is 735 feet, which gives an average dip from the locality near Vernal, Miss., where it comes to the surface, of about 25 feet to the mile; which corresponds very well to the dips of other strata of the Tertiary, which have been similarly traced. We are under serious obligations to Judge Johnson for the material he has so assiduously collected and which has helped so much to determine the geology of our southern tertiary formations.

WM. H. DALL,
Palæontologist U. S. Geol. Survey.

Washington, D. C., Sept. 13.

European Origin of the Aryans.

REFERRING to Dr. Isaac Taylor's letter in *Science*, Sept. 9, I must say that I cannot conceive how he can make the statements it contains, if, as he alleges, he has "carefully read" Omalius D'Hallow's writings.

Dr. Taylor's words are, "The comparatively modern theory that the Aryan race originated in the highlands of Central Asia, a theory of which D'Halloy does not seem to have heard." Now, in the article published in 1848, D'Halloy has these words: "On a voulu tirer la conclusion que ces langues (indo-germaniques) derivaient du sanscrit, et que tous les peuples qui les parlaient etaient originaires de l'Himalaya, deux propositions qui sont loin d'être incontestable."

As if this was not enough to make it clear as to what theories he was attacking, he specifically states in a note to page 19 of his "Eléments d'Ethnographie," referring to this article in the Bulletin of the Belgian Academy, that it was directed against the linguists who derived the modern European languages and peoples from Central Asiatic ancestry; whereas it was his view that the ancient Persian and Indian tongues were imported from Europe into Asia.

I imagine that if Dr. Taylor had not had before him the "necessity of modifying former [printed] statements," he would not have overlooked this positive testimony by Omalius to himself.

Media, Pa., Sept. 12. D. G. BRINTON.

The English Sparrow and Other Birds.

MY experience with the English sparrow accords with that of your correspondent X. in your issue of Sept. 2, 1892. Before this sparrow came and multiplied largely, my lawn was populated with cat-birds, red-birds (Cardinal grosbeck), robins, doves, bluebirds, yellow-birds, tomtits, chipping sparrows, wrens, etc.; but now the English sparrow has full possession of the entire premises. Now and then a cat-bird or a red-bird slips in as if to see whether he may again bring his family to their old umbrageous quarters, and to the rations which were provided for their support; but he is not reassured, and soon disappears.

The fecundity, energy, and perseverance of the little vandals are amazing. When the small fruits are abundant it requires a week of active shot-gun work to make them even cautious in visiting the fruit-garden. Some of them last spring took a notion to establish nests on the tops of window-shutters which opened under projecting eaves, and although their nests were swept off almost daily, they immediately began in each case to rebuild on the same spots, and continued this for at least a fortnight. In their nesting, as in some other things, they display more perseverance than discretion. The cats found that they were building in considerable numbers in a large hay-loft, and suppressed many a germ of mischief. The sparrows sometimes swarm like flies in the stable, where they will enter the troughs of horses, cows, and pigs whilst the animals are feeding.

I no longer shoot owls or hawks, but give them a welcome, and every cat and nest-hunting boy has the freedom of my premises.

Lexington, Va., Sept. 12. W. H. RUFFNER.

BOOK-REVIEWS.

Annual Report of the Board of Regents of the Smithsonian Institution to July, 1890. Washington, Government Printing Office, 1891.

THE Smithsonian Report for 1890 contains: First, the proceedings of the Board of Regents for the session of January, 1890; second, the report of the executive committee exhibiting the financial affairs of the institution, including a statement of the Smithson fund and receipts and expenditures for the year 1889–1890; third, the annual report of the secretary giving an account of the operations and condition of the institution for the year 1889–1890, with statistics of exchanges, etc.; fourth, a general appendix comprising a selection of miscellaneous memoirs of interest to collaborators and correspondents of the institution, teachers, and others engaged in the promotion of knowledge. This volume is also profusely illustrated, adding greatly to its value and interest. Among the illustrations are maps of the National Zoölogical Park; maps of the Niagara River; maps of Central Africa, before and after Stanley; pictures illustrating primitive urn burial, the age of bronze in Egypt, specimens of quartz fibres; and many others too numerous to mention in detail here.

The object of the memoirs included in the general appendix is to furnish brief accounts of scientific discovery in particular directions; occasional reports of the investigations made by collaborators of the institution; memoirs of a general character or on special topics, whether original and prepared expressly for the purpose or selected from foreign journals; and briefly to present (as fully as space will permit) such papers not published in the Smithsonian Contributions or in the Miscellaneous Collections as may be supposed to be of interest or value to the numerous correspondents of the institution.

Among the papers of special interest are those by J. Scott Keltie on "Stanley and the Map of Africa;" the "Age of Bronze in Egypt," by Oscar Montélius; the "Primitive Home of the Aryans," by A. H. Sayce; a "Primitive Urn Burial," by J. F. Synder; "Criminal Anthropology," by Thomas Wilson; "Antarctic Exploration," by G. S. Griffiths; "The History of the Niagara River," by G. K. Gilbert; and Weismann's "Theory of Heredity." The recently published translation of Professor Weismann's essays on heredity and allied topics has aroused the interest of the general public in the system of his biological ideas. Mr. George J. Romanes has undertaken a difficult task in endeavoring to present Professor Weismann's different theories on the subject, in a condensed form, but he has succeeded admirably. The papers on "The Ascent of Man," by Frank Baker, "The Antiquity of Man," by John Evans, and "The Progress of Anthropology" in 1890, by Professor Otis T. Mason, are of great value to those interested in the science of anthropology. The ancient problem of the squaring of the circle, which trained and untrained minds have striven in vain to solve for two and a half thousand years, is ably discussed in a paper by Hermann Schubert He makes an historical sketch of the problem from the earliest times to the present day, tracing the various theories from the times of pre-Grecian antiquity to the verdict given by Professor Lindemann of Königsberg in June, 1882: "It is impossible with ruler and compasses to construct a square equal in area to a given circle." These are the words of the final determination of a controversy which is as old as the history of the human mind. But the race of circle-squarers, unmindful of the verdict of mathematics, that most infallible of arbiters. will never die out so long as ignorance and the thirst for glory shall be united.

"The Progress of Astronomy" during 1889 is clearly shown in the paper by William C. Winlock, the compiler having made free use of reviews, in the various branches of astronomy, contributed by specialists to the *Athenæum*, *Nature*, *Journal of the Astronomical Society of the Pacific*. the *Observatory*, *Bulletin Astronomique*, the *Astronomical Journal*, and other periodicals. Among these are articles on stellar parallax, comets, meteors, variable and colored stars, stellar spectra, astronomical photography, the planets, solar spectrum, the sun, the solar system, and the minor planets. Astronomical bibliography for 1889 is given at the conclusion of this paper, including the most important books and articles for that year, which have attracted the compiler's notice; some few titles having been taken from reviews and catalogues, where the publications themselves have not been accessible. The title of the paper by Robert Simpson Woodward on "The Mathematical Theories of the Earth" implies a community of interest amongst astronomers and mathematicians. In fact, the study of the earth's crust, considered in its entirety and in its relations to similar bodies of the universe, has long been the special province of astronomers and mathematicians. Since the times of Galileo, Kepler, and Copernicus, it has supplied a perennial stimulus to observation and investigation, and it promises to tax the resources of the ablest observers and analysts for some centuries to come. The structure of the earth, as a mechanical and physical question, is closely connected with the origin and formation of its satellite and of the planets and satellites belonging to the same solar system. A paper "On the Physical Structure of the Earth," by Henry Hennessy, treats of this subject, under the following headings: "the mechanical and physical properties of the matter composing the earth, the rotation of the earth considered as partly fluid and partly solid," and a note concerning "the annual recession calculated on the hypothesis of the earth's solidity." The papers on "Glacial Geology," by Professor James Geikie; "The Mediterranean, Physical and Historical," by Sir R. Lambert Playfair; and the "History of Geodetic Operations in Russia," by Colonel B. Witshowski of the General Staff, and Professor J. Howard Gore, are full of interest.

The paper on "The Physical Basis of Musical Harmony," by Professor Sylvanus P. Thompson, is a history of the researches of Dr. R. Koenig, who is known not only as the constructor of the

Publications Received at Editor's Office.

BONNEY, G. E. Induction Coils. New York, Macmillan & Co. 12°. 281 p. Illustrated. $1.

COMMISSIONERS OF FISHERIES of the State of New York. Twentieth Annual Report, 1892. Albany, State Printer. 8°. 346 p.

DAY, DAVID T. Mineral Resources of the United States. Washington, Government. 8°. 679 p.

DOUGHTY, FRANCIS W. Evidences of Man in the Drift. New York. 8°. Paper. 18 p.

GRAFF, LUDWIG VON. Bibliothek des Professors der Zoologie und vergl. Anatomie. Leipzig, Wilhelm Engelnann. 8°. Paper. 358 p.

IMPERIAL UNIVERSITY OF JAPAN. Calendar for the Year 1890-91. Calendar for the Year 1891-92. Tokio, The University. 2 vols. 12°. Paper.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Exchange.—I have the finest shells of Anodonta corpulenta, C'p'r, and Suborbiculata, Say, in the world. Will exchange for fresh water, land, and marine shells, in large or small quantities. Have also for exchange 50 varieties of fresh water and land shells from Spoon River, Ill. DR. W. S. STRODE, Lewistown, Ill.

To exchange for books on birds or insects, or to back volumes of American Naturalist: Ecker's "Anatomy of the Frog," Packard's "Guide," Guyot's "The Earth and Man," Rockhill's, "The Land of the Lamas," Parker's "Biology," Shoemaker's "Heredity, Health and Personal Beauty," Dexter's "The Kingdoms of Nature," all new. M. J. ELROD, Ill. Wes. Univ., Bloomington, Ill.

For Sale.—About 1067 volumes of the private library of Dr. Nicolas León, formerly director of the Museum at Morelia, embracing publications of special value for Mexicologists, like those of Bishop Zumárraga (16th century), of Siguenza y Gongora, of Aleman, etc., the Missal of Spinoza, all very scarce: manuscripts on the history of Michoacán and other Mexican States, on the Tarasco (the Indian language of Michoacán) and several works, of which the only copy known to exist is in this collection. Parties interested in the sale please address DR. NIC. LEÓN, Portal de Matamoras, Morelia, Mexico.

Wants.

METALLURGICAL CHEMIST will give instruction in the metallurgy and chemical analysis of iron and steel. Complete or special courses applying to the manufacture of pig irons and steels, as well as to their uses. Address "METALLURGIST," care SCIENCE.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems, fossils, shells, archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Hortter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.

WANTED.—A position as zoological artist in connection with a scientific expedition, institution or individual investigations. Experienced in microscopic and all scientific work. References given if desired. Address J. HENRY BLAKE, 7 Prentiss Place, N. Cambridge, Mass.

YOUNG MEN destined for a medical career may receive instruction in branches introductory thereto, at the same time, if desired, pursuing the so-called elementary medical studies. Advanced students can have clinical instruction, use of modern text books, etc. Will take one or two students into my family and office. Such must furnish unexceptionable references. Quizzing by mail. Address Dr. J. H. M., in care of 417 Adams Avenue, Scranton, Pa.

CHEMIST AND ENGINEER, graduate German Polytechnic, Organic and Analytical, desires a position in laboratory or chemical works. Address 218½ E. 7th Street, New York, care Levy.

A MAN, 36 years old, of extensive experience, having the degrees of A.M. and Ph.D., desires a first-class opening as a teacher of Zoölogy and kindred studies in a college or university. Can furnish numerous testimonials or references as to success and skill in most modern laboratory methods. Address E. W. D., Md. Agr. College, College Park, Md.

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

finest acoustical instruments in the world, but as an investigator of great originality and distinction, and author of numerous memoirs on acoustics. In his *atelier* on the Quai d'Anjou he lives and works in seclusion, surrounded by his instruments, even as our own Faraday lived and worked amongst his electric and magnetic apparatus. Besides the great tonometer, his colossal masterpiece, Dr. Koenig's collection includes several large wave-sirens and innumerable pieces of apparatus in which his ingenious manometric flames are adapted to acoustical investigation. There also stands his tonometric clock, a time-piece governed, not by a pendulum, but by a standard tuning-fork, the rate of vibration of which it accurately records.

The final chapters of the volume deal with "Manners and Customs of the Mohaves," by George A. Allen; "Criminal Anthropology," by Thomas Wilson; "Color Vision and Color Blindness," by R. Brudenell Carter; "Technology and Civilization," by F. Reuleaux; the "Ramsden Dividing Engine," by J. E. Watkins; "Memoir of Elias Loomis," by H. A. Newton; and a memoir of "William Kitchen Parker." The life and work of Elias Loomis form no mean portion of the wealth of Yale University, and he published 164 contributions to astronomy, meteorology, and other branches of scientific research. He was a man possessed of considerable scholarship, of positive convictions, and of a willingness to follow at all hazards wherever truth and duty, as he conceived them, might lead. Professor William Kitchen Parker was born at Dogsthorpe, near Peterborough, June 23, 1823, and died suddenly of syncope of the heart July 3, 1890. He was a fellow of the Royal, Linnean, Zoölogical, and Royal Microscopical Societies; and honorary member of King's College, London, the Philosophical Society of Cambridge, and the Medical Chirurgical Society. He was also a member of the Imperial Society of Naturalists of Moscow, and corresponding member of the Imperial Geological Institute of Vienna and the Academy of Natural Sciences of Philadelphia. In 1885 he received from the Royal College of Physicians the Bayly medal, "*Ob physiologiam feliciter excultam.*" He was "an unworldly seeker after truth, and loved by all who knew him for his uprightness, modesty, unselfishness, and generosity to fellow-workers, always helping young inquirers with specimens and information; he was suddenly lost to sight as a friend and father, but remains in the minds of fellow-workers, of those whom he so freely taught, and of his stricken relatives, as a great and good man, whose beneficent influence will ever be felt in a wide-spreading and advancing science and among thoughtful and appreciative men in all time."

MARY PROCTOR.

St. Joseph, Mo., Sept. 9.

Trees of the Northern United States. By AUSTIN C. APGAR. New York, American Book Co. 224 p. 12°. $1.

THE ground covered by this handy volume is the study, description, and determination of the wild and cultivated trees found east of the Rocky Mountains and north of the southern boundaries of Virginia and Missouri. Its author, who is professor of botany in the New Jersey State Normal School, was evidently governed in its preparation by the idea that, while it can hardly be expected that the great majority of people will ever become scientific in any line, it is possible to induce nearly every pupil to become interested in and fully acquainted with such things, for instance, as the trees of his neighborhood. The plan of the work, therefore, is such as to first arouse the pupil's interest in the subject, and then to satisfy the consequent desire for information, attention being mainly directed to the leaves, the wood, the bark, and, in an elementary way, the fruit. These are the parts that must be thoroughly known by all who wish to readily recognize trees, and they, or most of them, may be found and studied throughout the greater part of the year. Though the book may be open to adverse criticism when viewed from the standpoint of the advanced botanists, it should be borne in mind that it is not written for them, but for the average teacher who has had no strictly scientific training. We may add that the illustrations are numerous and well adapted for the purpose in view.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

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Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
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Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

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SCIENCE

NEW YORK, SEPTEMBER 23, 1892.

LIQUID OXYGEN.

BY G. D. LIVEING, F.R.S., CAMBRIDGE, ENGLAND.

It is now fifteen years since Pictet and Cailletet first liquefied oxygen. Since then liquid oxygen has been the object of investigation by Olsewski, Wrobleaski, and more particularly by Dewar. At a lecture delivered at the Royal Institution in London, in June last, Dewar exhibited a litre of liquid oxygen in an open vessel; and he has prepared from time to time many litres of the liquid for the purpose of examining its properties. The method he uses is the same in principle as Pictet's, but he has much larger and better pumps for exhausting and compressing the gases. The essential thing is to cool the oxygen well below its critical temperature, or absolute boiling point, — 119° C. This is effected by means of some other gas, such as ethylene, which has a much higher critical temperature, namely + 10° C., and still a very low boiling point under atmospheric pressure, namely — 103°. Nitrous oxide, which has a critical temperature of + 53° C., and boils under atmospheric pressure at — 93° C., may also be employed. If the liquid ethylene be first cooled to — 80° C. by immersion in a mixture of solid carbonic acid and ether, it can then be easily reduced to — 108° by allowing it to evaporate at the pressure of the air; and by pumping away the vapor as fast as formed the temperature of the remaining liquid can be reduced as low as — 140°, twenty-one degrees below the critical temperature of oxygen. At this temperature oxygen is liquid if condensed until its pressure is equal to 30 atmospheres or thereabouts. On removing the pressure the liquid boils and is cooled by its own evaporation until under a pressure of one atmosphere it falls to — 182° C. By pumping away the gas as it is formed, the temperature is easily reduced to — 200° C., and the liquid then remains quite tranquil, and has the appearance of so much water.

Air may be liquefied in the same way, but the boiling point of nitrogen is somewhat lower than that of oxygen, namely — 193° C., so that when liquid air is allowed to boil away gradually, the residue becomes richer and richer in oxygen until nearly pure liquid oxygen is left.

The compressed oxygen met with in commerce always contains a little air and some carbonic acid, and both pass into the liquid oxygen. The carbonic acid crystallizes out in the solid state and renders the liquid milky. It may, however, be filtered through paper, and is then perfectly limpid.

To prevent the rapid deposition of hoar frost on the vessel containing the cold liquid, it has to be protected by an outward vessel, and the intervening space well dried. A beaker glass may be fitted with a varnished wooden cover and a smaller beaker to contain the liquid inserted through a hole in the cover, the space between the two being dried by a layer of phosphoric anhydride.

Oxygen does not show any increased chemical activity in consequence of liquefaction. As already mentioned it may be filtered through paper without affecting the paper. It is powerfully magnetic. Poured into a saucer of rock salt it at once assumes the spheroidal state, evaporating from its surface, but quite tranquil. If now it be brought near the pole of an electro-magnet, it will jump up, through half an inch or more, and adhere to the pole, looking like a blob of transparent ice. Of course it is not really solid, and as soon as the current of the electro-magnet is broken it falls down. Like iron it is attracted by either pole indifferently.

As it is the only transparent element which is magnetic, its behavior to light is of great interest with reference to the electro-magnetic theory of light. According to that theory it would be expected that light reflected from a plane surface of a transparent magnetic body, when the reflected and transmitted rays are at right angles, would not be polarized in the plane of incidence as it is when the reflecting body is diamagnetic. Dewar has found, however, that light incident at the proper angle and reflected by liquid oxygen at — 200° C. is very completely polarized in the plane of incidence.

Seen by transmitted light liquid oxygen, in a thickness of three or more inches, has a faint, but decided, blue tint. On examining the transmitted light through a prism, the cause is plain. There are several absorption bands, of which the strongest is in the yellow. These bands, as observed by Olsewski, and by Liveing and Dewar who extended their observations into the ultra-violet, are identical in position with, but much darker than, the diffuse bands produced by oxygen gas. They coincide with certain diffuse dark bands noticed by Brewster in the solar spectrum, and ascribed by him to atmospheric absorption because they were stronger when the sun was near the horizon than when he was high in the sky. The persistence of these bands indicates continuity in the physical state of oxygen when passing from the gaseous to the liquid state.

It was observed by Jannsen, and Liveing and Dewar's observations tend to the same conclusion, that the intensity of these diffuse bands, for a given thickness of the gas, increases as the square of the density. On the kinetic theory such a result would follow if the molecules of oxygen absorb the corresponding rays when they are under the influence of other molecules but not when in free path. For both the number of the molecules in a given thickness, and the frequency of their collisions, increase directly as the density.

Furthermore, oxygen gas produces, besides these diffuse bands, certain absorptions consisting of rhythmical groups of fine lines. These, in the solar spectrum, are known as A, B, and α; and it was Egoroff who identified these lines with the absorptions of oxygen gas. Their intensities appear to increase directly as the density, and may therefore fairly be ascribed to the action of the free molecules of oxygen gas. What becomes of these absorptions when the gas is liquefied? Olsewski, looking through 30 millimeters of the liquid, observed an absorption at the place of A. Liveing and Dewar, looking through six inches of the liquid, saw absorptions corresponding to both A and B, but somewhat different from those due to the gas. As produced by the gas, A is a group of lines which are very close together on the less refrangible side and are set farther and farther apart as they get more refrangible; so that the group when seen with low dispersion has the appearance of a shaded band with a strong, sharp edge on the less refrangible side, gradually fading away on the more refrangible side. B is on the blue side of A, and is precisely similar to it, but not so intense. α is still more refrangible, and still weaker. The absorption of the liquid at the place of A is also a shaded band, but its shading is turned the other way. Its sharp and strongest edge is on its more refrangible side, and it fades away on the less refrangible side. The strong edge does not correspond exactly with the strong edge of A, but is a little more refrangible, though still falling within the group. The band of the liquid could not be resolved, like A, into lines. The band corresponding to B is precisely similar, but fainter. It overlaps B, and has its strong edge a little more refrangible than that of B. It seems that we have in these bands the absorptions due to the individual molecules of oxygen, only modified in the way described by the change from gas to liquid; and we should infer that the molecules of the liquid are still the same as those of the gas.

There is more difficulty in determining the physical characters of oxygen than the facility with which it can be manipulated

would lead one to expect. It is especially difficult to find suitable vessels for it. Thin glass in one piece, like test-tubes and beakers, does very well, but thick glass and all kinds of cement are mostly cracked by cooling; and massive vessels involve the waste of a large volume of the liquid in the process of cooling them down to $-180°$ C. With some trouble, however, Liveing and Dewar have succeeded in measuring the refractive index of liquid oxygen, at its boiling point, for the D ray of sodium. They used a hollow prism with glass faces clamped together and made tight at the joints with glycerine. The refractive index so found was 1.2236, somewhat less than that of water in the liquid state, which, near its boiling point, is about 1.32.

The density of oxygen at $-182°$ is 1.124. These figures give for the refraction constant, $\frac{\mu^2 - 1}{(\mu^2 + 2)\,d} = .1265$, and for the corresponding refraction equivalent 2.024. The mean values of the constant and equivalent as found by Mascart and Lorenz for gaseous oxygen are the same as those here given for the liquid.

Ozone is more easily liquefied than ordinary oxygen, but is formed with a storage of energy, and in a concentrated state is very explosive. When oxygen, ozonized in a Siemens' tube cooled with solid carbonic acid and ether, is passed into liquid oxygen, the ozone is dissolved and imparts a deep-blue color to the liquid. The boiling point of oxygen is lower than that of ozone, so that, as the oxygen evaporates, the strength of the solution and the depth of its color increase. The last drop has a steel-blue color, and explodes spontaneously with violence. If a glass tube conveying ozonized oxygen be cooled down to $-180°$ C, or nearly so, the liquid ozone may be seen condensing on the sides and running down. It has been found impossible to collect the liquid, however, for no sooner have two or three small drops run together than they explode, shattering the vessel.

It is certainly remarkable that a substance which, unlike many substances which are formed with a storage of energy, is so unstable at high temperatures, should also be very unstable at low temperatures. Perhaps its instability may be connected with its powerful absorption of light, which is put in evidence by its deep color. What the form may be in which its excessive energy is stored, we can at present only guess at. Can it be that the three atoms, of which its molecule consists, rotate with great velocity about their common centre of mass in exceeding close proximity, and that a small impulse from without increasing the velocity as well as the distance of the atoms suffices to send them off in hyperbolic orbits to scatter destruction amongst the other molecules which they encounter? This might be the case if the velocity of the atoms greatly exceeds the velocity of agitation of the molecules on which the temperature depends.

NEW DISCOVERIES AT BAOUSSÉ ROUSSÉ, NEAR MENTONE.

BY THE MARQUIS DE NADAILLAY.

I KNOW of no discovery touching pre-historic times more remarkable than those made in the caves of Baoussé Roussé, between Mentone and Ventimiglia, on the borders of France and Italy. These caves were first discovered in 1872 by Mr. Rivière. Since that time this learned gentleman has vigorously prosecuted his excavations,[1] and they have yielded numerous human skeletons, all belonging to the celebrated Cro-Magnon race, who at the end of the quaternary period, or perhaps at the beginning of neolithic times, ruled not only the south of France, but also all the Mediterranean shores. It is these same men we meet with under the names of Iberians, Ligurians, Sicanians, perhaps also under those of Pelasgians and Berbers. It is their bones that the brothers Siret found in the south of Spain, Professor Sergi in Italy, and Mr. Rivière at Baoussé Roussé.

All the bones, wherever found, show a great similitude. They are robust, and bespeak an athletic constitution and a large muscular power. The men were remarkably tall, the crania are dolichocephalic, the tibias platycnemic, but since Dr. Manouvrier's observations,[2] we cannot see there an inferior character. The cranium of the first skeleton found (an old man) measured 1,590 cubic centimeters. The cranium of the woman found next to him 1,450 cubic centimeters; but this last measurement is not quite accurate, on account of the decomposed state of the bones.

The man had upon his head a net of small shells (*Nassa neritea*), and bracelets of shells round his arms and legs. Near him Mr. Rivière collected more than 150 stone implements, and also numerous bones of mammals, birds, and fishes, evidently the food of these people.

New discoveries quickly followed the first ones, and we always find a particular mode of inhumation, which, I believe, still exists, or lately existed, in some Indian tribes. The bones of all the adults, after the total decomposition of the flesh, were painted in red with the help of peroxide of manganese or other substances frequently met with in the different caverns.

The last excavations took place in February, 1892, in one of these caves, named Barma Grande. A communication made to the Academie des Inscriptions, March 4, 1892, informed us of the discovery, at 8 metres below the level of the ground, of three new skeletons, a man, a woman, and a young subject whose dentes sapientiæ had not yet evolved. They had been buried on a bed of cinders, broken fragments of charcoal, remains of all sorts, evidently the hearth on which the family cooked their victuals. The boy wore a necklace formed of two rows of the vertebræ of a fish and one row of small shells. At different points hung pendants cut out of the canine teeth of stags, decorated with parallel striæ. The man had also a necklace of fourteen canines of the stag, also striated. With the skeletons were found a certain number of stone instruments, some of them finely worked, but none of them polished, and some bone implements of very gross fabrication.

The man was very tall, and, if we judge by the length of the thigh-bone (545 millimeters), his height must have exceeded two metres[3] (6 feet 6 inches). The boy, who had not yet attained his manhood, measured 1.63 metres (5 feet 8 inches). We must also remark the extreme wear of the teeth, very apparent already in the boy, and which in the man extended to their very root. I have already said that the caves of Baoussé Roussé yielded numerous bones of mammals, but none of them belonged to the extinct species, not even to the reindeer which is found in the south of France even at a late period. On the other hand, no polished stone implement was ever found in these caves. We can therefore give these men a pretty accurate date, and place their existence, as I have said, at the end of the quaternary or the beginning of the neolithic times. One cave remains as yet unexcavated. It belongs to the Prince of Monaco. Orders are given that the excavations shall begin next spring. If they produce anything of interest, I will not fail to report them to the readers of *Science*.

Rougemont, Sept. 2.

THE PREVENTION OF CHOLERA ASIATICA.

BY HUGH HAMILTON, M.SC., M.D.

THE symptoms of cholera are so well known that it is a matter of common knowledge; however, to make the subject plain, it is very similar to *Cholera Morbus*, well known to every American, which is due to indigestion and disorder from the eating of improper fruits or too large amounts of perfect raw fruit. In *Cholera Asiatica* there is vomiting, purging, chill, sweat, death in a longer or shorter period. When *Cholera Asiatica* is epidemic, many of these lesser complaints of the digestive apparatus pass under its name, and, as a consequence, many remedies seem to cure the disease, which in fact is probably not *Cholera Asiatica* but *Cholera Morbus*, which is bad enough.

[1] They are related at length in "L'Antiquité de l'homme dans les Alpes maritimes." Paris, I. B. Baillière et fils, 1887.

[2] Dr. Manouvrier has shown that platycnemia is produced by long and hard work continuously acting on the muscles of the leg. It is found to a large extent in hard walkers, in populations living near the mountains. It is more frequent in men than in women; and it very rarely, if ever, exists in children.

[3] The state of the bones precluded any accurate measurement, and comparison, when we reach these extreme heights, is very difficult. The Museum of Paris possesses the skeleton of a giant who measured 2.14 metres, and whose thigh-bone measured 566 millimeters.

But to the science of the subject. The cause of *Cholera Asiatica* is the bacteria, or vegetable fungus, found in the body of those dead from the disease and in the ejections and dejections of those afflicted with it. These bacteria belong under the head of those *peculiarly* fatal to mankind. It assumes the shape of a comma, i.e. (,), or an S-shape. It belongs in the class *Spirillæ*, i.e., S-shaped, but has been described by Professor Koch as *Komma bacillus.*[1] Now this *comma bacillus* is found in the intestines of fresh cholera-corpses and in the dejections of those ill with the plague. This being the source of the disease, although not its origin, we readily see that we must study its habits of propagation; its physical characteristics upon certain *organic* matter; its behavior on *living* material. Then we can scientifically regard its prevention.

It grows quickly upon a surface of gelatinous substances, and renders it after a while fluid. Looked at by a strong glass, capable of magnifying it 100 diameters, it looks like a funnel-shaped ring curled upon itself at the edges, if the gelatine or glue has been stuck with a needle.[2] Upon the smooth surface of gelatine it has a rosy shimmer. It requires a heat of the human body to grow, that is, 98.5° F. (37½° C.), so that it will not propagate at ordinary temperatures of the room. It grows on potato parings and pieces of bloody meat at 30° to 40° C. (86° to 104° F.), at 16° C. (61° F.) it ceases to grow, at 10° C. (50° F.) it exists, i.e., is not killed completely.[3] Just here the nature of heat and cold may be noticed. Cold, agreeably with most vegetable seeds or spores, merely places them in a state of non-germination, particularly if dry; instances are easily brought to one's mind in a crude way by the vitality of the wheat, barley, rice, etc., exposed to excessive cold, while in a congenial temperature and moisture they grow. Heat, however, when applied to the boiling point, destroys all germination; because it is a rapid method of degeneration. Further, this *comma bacillus* is *aerobic*, i.e., requires air or oxygen from the atmosphere to live. The bacilli are divided into classes that are *ana*-aerobic, *semi*-ana-aerobic (?), and aerobic, meaning without atmospheric oxygen; sometimes requiring oxygen and sometimes not free oxygen; the last as we have above stated.

The method of discovering this *comma bacillus* in the dejections next engages one's attention. It is easily cultivated under aseptic conditions upon a gelatine surface exhibiting the characteristics spoken of above. It is colored by the method known to all bacteriologists, that of Professor Gram.

Solution No. 1, *a*, watery solution of aniline oil; *b*, saturated accoholic solution of Gentian violet. *a* is made as follows: —

Aniline oil, one (1) part;
Distilled water, twenty (20) parts.

Filter. To the clear filtrate (it must be shaken and filtered until clear) add 5 parts of the *b*, i.e., saturated alcoholic solution of pure Gentian violet, to 100 parts of *a*, aniline water, made above.

After drying on a little piece of glass, the dejecta of a patient sick with *Cholera Asiatica* spread very thin, and then immersing it in the solutions, mixed as above, for three (3) minutes, and then for three (3) minutes more in a solution, 2, made as follows: —

$$\left.\begin{array}{l}\text{Iodine, one (1) part.}\\ \text{Iodide of Potassa, two (2) parts,}\\ \text{Distilled water, three hundred (300) parts.}\end{array}\right\}\begin{array}{c}\text{solution}\\ 2\end{array}$$

until all color seems to disappear; then dry the little glass and view under a microscope to 1,000 diameters; the *comma bacillus* will be larger than an ordinary comma (,).

When we really find this *comma bacillus*, then the patient has the epidemic cholera. Upon this fact is founded all the advance in our treatment of it. Here the scientific value of hygienic and sanitary regulations becomes apparent. Pardon me just here for referring to the recent work of Professor L. Brieger, the president of the Medical Section of the Imperial Institute for Infectious Diseases at Berlin, Germany, upon the immunity from the fatal effects of *Cholera Asiatica* which he has been able to produce in Guinea-pigs. The microbes of cholera, technically *cultures*, were raised on agar-agar gelatine, put into peptonized meat-broth, and kept upon ice several days, then injected into the Guinea-pigs, about four cubic centimeters, for five or six days successively, when they could withstand the cholera cultures which, when given to other *unprotected* Guinea-pigs, quickly produced death.[4] Of course, this immunity of the mammal, Guinea-pig, presents a vista of relief by protection similar to that given to us by vaccination from small-pox, and promised by "Koch's tuberculin" in the treatment of consumption (Tubercular Phthisis). We look forward to that day of *scientific* medicine.

The careful, methodical German has been directed by his imperial officers to be very careful in personal hygiene and to observe to the letter the regulations in the case of those sick from *Cholera Asiatica*, while the doctors have been compelled to carefully examine each case by the methods above given, and, if unable to do so, to send some of the diarrhœal fluids to the district police stations to be examined at once at government expense — so careful are they to determine what the disease really is. Then the patient must be isolated, his nurses rendered strictly *a*-septic before being allowed to leave the apartments, all the attendants to be washed in solution of carbolic acid twice daily, and the patient too. No eating, drinking, smoking, or anything in contact with the mucous intestinal tract, such as mouth or nose, allowed in anyone except under strict *anti*-sepsis.

By this means it has been possible to prevent the spread of the disease to another case, if *discovered in time*. This element of *unwell*, but not *ill*, persons with *Cholera Asiatica* is the problem; the half-sick ones damage to the utmost hygienic arrangements, and bring disgrace on the attempts of "State" medicine to prevent its spread. This brings one to the application in a more extended sense of isolation or detention in quarantine of numbers of people. This is a troublesome problem to successfully solve; it is now taxing all the wit and wisdom of our land. We trust it may be successful.

[5] The best disinfectants are:—

1. Lime-water; a quantity equal to the amount of the stool and allowed to cover and remain upon it one hour. 2. Chloride of lime (small boxes); two tablespoonfuls on each stool and allow to remain on it twenty minutes before cleansing the utensils, then washed with lime-water. 3. A soft soap of potash, mixed with 5 per cent of crude carbolic acid solution. This to be used for all vessels, clothes, clothing, both body and bed. 4. A one per cent solution of carbolic acid for bodily bathing of patient and nurses. 5. Daily scrubbing the floor and furniture with lime-water, and two hours afterward with a one per cent carbolic acid solution in the patient's room. 6. A boiling of an hour of all clothing. 7. All the shoes, effects, etc., in the room of a patient either afflicted or dead from *Cholera Asiatica* shall be disinfected and not used for ten days.

The conclusion of the matter is:—

Live carefully; keep away from those afflicted with the disease, except specially protected as aforesaid; keep clean; isolate the patient and his attendants.

Harrisburg, Penn., Sept 13.

[1] Berl. Klin. Wochenschr., 1884, Nos. 31, 32, and 32a.

[2] Dr. Carl Gunther's Bakterol: Leipzig, 1890. Pl. viii., Fig. 47.

[3] Bakterol: Diagnos: Eisenberg, Hamburg, 1891, p. 256.

[4] Deutsch. Med. Wochenschr., 1892, No. 31 (Aug. 4, 1892).

[5] Regulations of Minister of Interior, Germany, Aug. 1, 1892.

FLORIDA PITCHER PLANT.

BY CHARLES B. PALMER, A.M., COLUMBUS, OHIO.

AMONG the many curious and interesting objects which came under my notice during a residence of several years in Florida, none interested me more than an insectivorous plant (*Saracenia variolaris*) which is common about Orange Heights, in eastern Alachua County. I have no reason to suppose that it is limited to this locality, but this is the only place in which I have observed it. It is a modest plant, seven or eight inches in height, growing in damp situations among the coarse grass of the pine woods.

It bears a single radical flower, the most striking feature of which is the style, which expands into a broad umbrella, entirely enclosing the flower. But it is not of the flower, but of the pitcher-like leaf that I wish to speak.

When the young leaf first makes its appearance, it is spatulate in form, with a simple notch on one side near the end, ranging upward at an angle of about 45 degrees. As the plant grows, the sides separate, forming a tube, while the notch increases in size and rotates in direction, until it becomes an ample opening ranging downward at an angle of about 45 degrees. At the same time the end of the spatula enlarges into a dome-shaped hood, the upper lip at the opening projecting well forward and downward over the lower. The tube is largest at the top, narrowing gradually to a point a short distance above the ground. The front or open side of the tube has a narrow rib, the rest of the circumference being round and smooth.

Being unable to find in botanical literature any adequate account of the manner in which this plant performs its remarkable functions of catching and devouring insects, I was led to make the study myself. Placing several of the plants in flower-pots for continuous observation, dissecting numbers of others in the woods almost daily, and continuing these observations during several different seasons, the little pitcher has come to seem like a familiar friend, and has yielded me an amount of pleasure and satisfaction that would seem incredible to any but a lover of nature.

If one were to say that he had seen a tree which could catch and eat squirrels, rabbits, field-mice, etc., he would be set down as a bungling imitator of the celebrated Baron; but here is a frail plant which we tread upon unnoticed, that actually captures, devours, and digests number of animals endowed with much greater activity, and doubtless with higher powers of perception, than any mammals.

If the plant has any odor attractive to insects it is not perceptible to human olfactories. But when near the opening they seem possessed with a desire to enter, and the way is open and easy. At the edge of the opening they are seen to sip a secretion of the plant, and immediately hasten on to the interior. Here some of them will continue to eat ravenously until they are seized with a sort of palsy, causing them to tremble violently, release their hold, and fall into the liquid at the bottom of the tube. Others, after entering the dome, become frightened and endeavor to escape. And here is discovered one of the remarkable features of the plant — an arrangement clearly intended to deceive the unlucky prisoner. The hood projecting over the opening forms a dark background, while the opposite side of the dome is brilliantly lighted by means of more than a hundred transparent spots or windows. Just as a bird which has entered a room by a dark passage, beats against the window-pane, so the poor insect exhausts his strength at the windows of his prison, and finally falls exhausted — literally "in the soup."

The bath seems to cure their palsy, for they invariably struggle vigorously to escape by climbing up the side of the tube. But the effort is vain. It seems remarkable that insects which walk upon glass and other smooth surfaces at will can make no progress here. The inner surface of the tube has a wonderfully smooth feel, and under the microscope is seen to be covered with very fine hairs forming a nap in the downward direction. About half-way up the tube there is a change in the appearance. It looks as if the lower part were wet and the upper dry, but the microscope shows that the appearance is caused by a different arrangement of the hairs on the surface. On the upper half, they appear like bundles of grain with the ends well spread. The purpose of this arrangement is not apparent; but having on one occasion found a larva at the half-way point, it occurred to me that possibly certain species had feet able to traverse the lower half, and such would be stopped by the different arrangement above. However this may be, the insect which once enters this doubly and trebly guarded prison "leaves hope behind." Even when rescued, he seems unable to resist the temptation to taste again the insidious nectar which leads him to his doom. Cut away the hood, and let a blade of grass down into the tube. A half-dead fly climbs eagerly out. Too weak to fly, he can be handled at will. Place him on the outside of the tube, an inch or more from the opening, with head turned away from danger. He staggers forward a few steps, stops and considers, then like the confirmed toper in front of a saloon, turns around and goes back for one more drink. At the first taste, he becomes crazed, sips ravenously till the tremens comes on, and drops him down to certain death.

The number and variety of insects disposed of by a single plant is astonishing. Every order is represented. One would think that a grasshopper, large enough to reach across the tube and almost close it up with his body and long legs, would have small excuse for being in such a place. But there he is slowly dissolving. Beetles, moths, larvæ of numerous kinds, including large woolly caterpillers, all go the same way. The hymenoptera are represented by ants, but I have never found any species of bee, though I have searched diligently for that special purpose.

The statements of certain botanists that the pitchers are "half filled with water containing drowned insects," and that "it is difficult to believe that they have any connection with the economy of the plant," need revising. A chemical analysis of the fluid is wanting, but it is a secretion of the plant and not rain-water. The construction of the plant makes it impossible for rain to enter. Furthermore, I have seen a plant which had been cut off at the root send up a new leaf, mature its pitcher, secrete its fluid, and begin business, during a period in which no rain had fallen.

In every healthy pitcher may be found insects still alive and struggling; others dead; others farther down in the mass, coarsely broken up; and at the bottom only a pulp. The fact that the elytra, mandibles, and other hard parts of beetles, are dissolved with the rest, shows that the plant has remarkable digestive powers. Unlike animals, it has no means of rejecting unsuitable portions of food. Everything goes. The front door is always open, there is no back door, all sorts of visitors enter, none escape, every shred disappears.

CURRENT NOTES ON ANTHROPOLOGY.—XV.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The Antiquities of Catamarca.

AMONG the mysterious civilizations of the New World which were extinguished before the arrival of the Europeans, that of the Province of Catamarca, in north-western Buenos Ayres, is not the least difficult of solution. In this region, over an area about four hundred miles square, the vestiges of a dense population are numerous, and there are abundant proofs that there prevailed a stage of culture definitely above that of the Pueblo dwellers of New Mexico. The ruins of stone-built structures are abundant, and are the only instances of such that we find east of the Andes in the whole of South America. They begin at a height of twelve to fifteen thousand feet, and continue down to the mesas and plains of the lowlands. From their positions and plans most of them were evidently defensive works, occupying points of vantage, and with walls three to five feet in thickness. The entrances are concealed or sometimes none exist, ladders having evidently been used by the inhabitants. They were acquainted with the use of copper, gold, and silver, made excellent pottery, wove fabrics with skill, cultivated maize extensively, and buried in mounds.

An interesting but brief notice of these remains is published by Francisco P. Moreno in the "Revista del Museo de La Plata," 1891. He considers the remains are anterior to the conquest of the country by the Incas about 1450. This is probable, but it would not militate against the evidence I have brought forward in my "Studies of South American Languages," p. 54, that the natives of Catamarca were themselves of the same blood and language as the Incas.

Central-American Languages.

The Empress Catherine II. of Russia at one time planned publishing specimens of every language on the face of the globe, but lost interest in her scheme, and dropped it before completion. When at St. Petersburg a year ago, I inquired about the material collected by her orders, but left unpublished. The Librarian of the Imperial Library could give me no information about it.

Now, part of it arrives in a publication from Costa Rica entitled "Lenguas Indigenas de Centro-America en el Siglo XVIII. MS. del Archivo de Sevilla. Publicada por R. F. Guardia y Juan Fernandez Ferraz. 1892." The editors do not state, and do not

seem to be aware, why these twenty-one vocabularies were collected by a priest in 1788; but I have no hesitation in attributing them to the desire to comply with the wishes of the empress of the Russias, and am sure it could be readily shown.

Their publication is praiseworthy, and carefully made; but it does not offer any new material on Central-American dialects in the sense of new stocks. Two of the Maya dialects, the so-called Pupuluca and Subinha, are slightly different from those already known; and the language termed "Lean y Mulia" is the same as what we know from other sources under the more appropriate name Xicaque. The vocabularies include the Chapanec of Chiapas and several Costa Rican dialects, though the majority are branches of the Maya family.

An Anatomical Criterion to Distinguish Male from Female Skulls

It has long been most earnestly desired to discover some anatomical feature which would enable us to distinguish the skulls of the sexes. Two years ago Virchow declared that all alleged modes of differentiation so far discovered were worthless. Very lately Dr. Thiem-Cottbus, in the "Archiv für Klinische Chirurgie," Band 37, describes what seems a satisfactory craniological criterion of sex.

The os tympanicum forms part of the posterior wall of the glenoid cavity of the inferior maxillary, and also closes in front and below the bony meatus of the ear. It arises perpendicularly from the petrous portion of the temporal bone posteriorily, and turns backward, in the woman at about half the height of the mastoid process, but in man at a less height. In the male, the bone developes a sharp edge, which divides to form the sheath of the styloid process; but in woman this sharpened edge does not exist, the bone is rounded into a tubercular form, and the fossa is shallower and flatter.

Thus, in the male this fossa-tympanico-stylo-mastoidea is small, and the posterior wall of the glenoid cavity extends so deep that it is not possible for the condyloid process to slip over it. In the female, it is so much more spacious that this feature alone will serve to distinguish the crania of one sex from the other; and it also explains the surgical fact that luxation backward of the inferior maxillary is observed only in women.

An Etruscan Ritual Book.

Before Rome was founded, the powerful federation of the Etruscans had spread an advanced civilization over central Italy, capping her hill-tops with fortifications, whose impregnable walls still bid defiance to time. But by the beginning of our era, the Etruscan people, and language and religion, had disappeared, leaving no testimony but their tombs. From these some five thousand inscriptions have been copied, but they tell us little. Not a single word of the language has been identified beyond peradventure.

The Etruscan religion profoundly modified that of Rome. They were a literary people, and in very early times wrote numerous religious books. These are referred to by Livy as works of divination, *fatales libri*, and by Cicero as books of ritual. *Etruscorum rituales libri*, or as Etruscan documents, *chartæ Etruscæ;* and even in the latter's day, they were in use by the Roman priesthood.

It seems an incredible piece of good fortune that one such Etruscan Ritual Book should turn up in fair preservation in the year 1891; but such seems to be the case. Two or three centuries, B.C., a mummifier of Alexandria bought a lot of waste paper and old rags for use in his business, and employed some of it in wrapping the corpse of a young lady. About 1849 her mummy was brought to Austria, and last year in her wrappings this Etruscan book was identified by Professor Krall. The Vienna Academy of Sciences has undertaken its publication, and on its appearance I shall return again to its curious history and character.

Ethnography of the Finns.

One of the most interesting questions in the ethnic history of the north of Europe is that concerned with the origin and migration of the Finns. They are ancient settlers, as they were known to the Romans of the time of Tacitus as dwellers on the Baltic Sea. In language they are first cousins of the Magyars of Hungary and also of the Samoyeds of Siberia. Indeed, some maintain that their name "Suomi" is from the same radical as "Samoyed."

Those resident in Finland proper rarely show any marked Mongolian appearance, as I can say from personal observation; but their strain is deeply Aryanized. A much less familiar branch of them are the Sirieni or Syränen, who dwell in north-eastern Russia, on both slopes of the Ural Mountains, extending east to the valley of the river Ob, on which the town of Muji is one of their principal resorts, in latitude 65° north.

This group has been carefully studied by M. Stephen Sommier, whose volume, "Sirieni, Ostiacchi e Samoiedi dell'Ob," appeared a few years ago in Florence. From numerous anthropometrical measurements he carried out, he satisfactorily showed that the Sirieni are Germanized Finns, quite like their relatives on the Baltic, and differing widely from the Ostiaks and Voguls to the east. It is probable, indeed, that the Sirieni, who are much given to trading and wandering, are an offshoot of the western branch of the stock, rather than the eastern.

NOTES AND NEWS.

THE sixth annual convention of the Association of American Agricultural Colleges and Experiment Stations will meet in New Orleans, La., on Nov. 15, as announced by the chairman of the executive committee. Titles of papers should be sent to C. F. Atkinson, Auburn, Ala., before Oct. 1. It is proposed to discuss the different subjects assigned to station workers for the Columbian exhibition.

— A timely book is "The Career of Columbus," by Charles Elton, M.P., announced by the Cassell Publishing Company.

— Professor D. S. Margoliouth of Oxford has undertaken to translate the great Arabic geographical dictionary.

— G. P. Putnam's Sons are about to publish a new edition of Professor F. W. Taussig's "Tariff History," enlarged by about 100 pages of new matter, including a discussion of the McKinley Bill.

— Francis P. Harper will publish shortly a new and important edition of Lewis and Clarke's "Expedition over the Rocky Mountains," on which Dr. Elliott Coues has been engaged for some time. He is specially fitted for the task, and the index to this faithful reprint of the Philadelphia edition of 1814 will be of great scientific value.

— Harper & Brothers will soon publish an interesting work by Walter Besant, entitled "London," which will not be a history of the city as a body politic, but the story of the life of the people at different periods from the earliest historical records to the times of the Georges, and will be fully illustrated.

— Edward Stern & Co., Philadelphia, will publish at once "In Arctic Seas," by Dr. R. N. Keely, in which the author, who accompanied in the capacity of surgeon the West Greenland Expedition last summer, gives an account of the incidents of the voyage of the "Kite," conveying Lieutenant Peary's party to McCormick's Bay.

— On Sept. 1, *The Open Court* (Chicago, Ill.) began the publication of a series of articles by Mr. Charles S. Peirce, to be entitled "The Critic of Arguments." (The word *critic* here means an art, like *logic*.) This series will be devoted to a critical and historical discussion of the methods of reasoning. Mr. Charles S. Peirce is one of the most distinguished scholars and mathematicians of which America boasts. But especially in the department of modern logic has his work contributed, perhaps more than that of any other living investigator, to the permanent advancement of science. The results of his thought are, however, for the most part locked up in the proceedings and reports of learned societies, and now for the first time, in *The Open Court*, are they to be presented in a less rigid and technical form, and made accessible to all who place a value on right thinking.

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ANCIENT MEXICAN HERALDRY.

BY AGNES CRANE.

THERE can be no more striking instance of separate evolutions on the same plane of thought in different grades of culture than the independent development of a system of heraldry, or "armory" as it should be rightly called, in the western hemisphere by the aborigines of ancient Mexico long anterior to the epoch of the Spanish Conquest in 1521. It was based, like the heraldic systems of Europe, on personal distinction in battle, which seems to have been originally the sole source of ennoblement among all people, and possessed the same intent to blazon forth personal exploits and record individual achievements.

It may seem a strange anomaly to refer to the "coat armour" of painted warriors not overburdened with clothing, adorned with labrets, nose-crescents of gold and other barbaric ornaments, whose personal prowess in warfare was exerted to capture their enemies alive in order that they might be offered as living sacrifices to the gods of the victor in the combat. Yet we have the authority of Logan, the historian of the "Scottish Gael," for the statement that so late as 1644 the Highlanders under Montrose fought divested of most of their clothing at the battle of Tippermuir. It is equally true that the war-shields and gala-shields of the ancient Mexican warriors were "charged," in many instances, with "animate designs" and various emblems recording the gallant deeds of arms, of the individuals who bore them, and the distinctions and "augmentations" granted them in recognition thereof by their so-called "emperor" or chief-priestly ruler. In others, again, they carried phonetic symbols rudely expressing the name and rank of the owner, like the "canting arms" or *armes parlantes* which formed the larger proportion of the early coats in European heraldry with as great an effect as the spear in the much discussed coat of Shakespeare, the padlocked heart of the Lockharts, the four emblazoned hands of the Quatermaines, the three cocks of Cockaigne, and the whelk shells of Shelley. A similar canting-shield was carried by the leader of the Tlaxcallan forces which accompanied Cortes on his way to Tetzcoco. It is depicted in a native chronicle as exhibiting a monstrous face with eyes borne on the palms of severed hands and belongs evidently to the same category. The name of this Tlaxcallan ruler, Maxixcatl, is expressed in the same pictorial record by the hieroglyph of an eye on the palm of a hand, and the symbol for water which yields in the Aztec or Nahuatl language the elements *ma, ix, atl* from *maitl*, hand; *ixtli*, eye; and *atl*, water. It is obvious that the elements *maix* are conveyed by the eyes on the palms of the severed hands on the shield to which we refer.

Much that is both interesting and suggestive on this subject will be found in the remarkable memoir "On Ancient Mexican Shields," from which this example is taken, contributed by Mrs. Zelia Nuttall, special assistant in Mexican archæology of the Peabody Museum of Cambridge, Massachusetts, to a recent issue of the "Internationales Archiv für Ethnographie," Vol. V., Part I., 1892. It gives full details with colored illustrations of the heraldic devices on war-shields and gala-shields borne in religious dances as figured in various native MSS. and Codices, described in the Spanish inventories, or depicted on ancient Mexican shields still preserved in the museums of Mexico City, Vienna, Stuttgart, London, and at Castle Ambras in the Tyrol. The supplemental accounts derived from native sources and old Spanish chronicles of the system of rewards granted by the chief ruler to successful Mexican braves in savage warfare are of special interest and value.

This system was, to say the least, peculiar. The neophyte went forth to battle clad in white raiment, with a blank shield. On capturing an enemy alive he was granted the privilege of painting his body yellow, his face red and his temples yellow, and the right to wear a colored uniform and a shield to match his war-paint. The Mexican war-shield was round, like the Highland Targe

> "Whose brazen studds and tough bull hide
> Had death so often dashed aside,"

and described by bards more ancient than Sir Walter Scott as painted red, spotted, varied, or chequered. In Old Mexico the capture of two foes was rewarded with a more elaborate costume, a gold *yacametz* or nose-crescent and a shield decorated with feather pellets. The warrior who took three prisoners alive received a wooden shield with a border of blue, the royal color, or one displaying parti-colored stripes with a fringe attached to it. Further captures were rewarded with ornaments of gold, or precious stones, and the images of these quartered on the shields "in augmentation" record the nose-crescents and labrets won and worn by those who had performed such signal deeds of valor.[1] One shield bears four, and another ten of these designs which present some resemblance to the thirty-seven crescent-shaped ornaments of beaten gold adorning the magnificent feather headdress of the time of Montezuma described by Mrs. Nuttall in the first number of the first volume of "The Peabody Museum Papers." They recall, also, the buckles considered by recent authorities on European heraldry as a military badge, one of which is actually borne on the shield of the Pelhams, Earls of Chichester, to commemorate the ancestral share in the capture of King John of France at Poictiers. In the same manner a negro's head is quartered on the family shield of a "highly well-born" German family as a record that an ancestor took prisoner a black princess during one of the crusades.

[1] It would be interesting to know if the additional labrets and nose-crescents were quartered on the shield because of the personal inconvenience of wearing more than one of these distinctions.

Thus, simultaneously with the knights of old in Europe, the warriors of ancient Mexico "obtruded the blazon of their exploits on their company." Mrs. Nuttall gives the Aztec word *totopalitoa* as the equivalent of "to blazon forth or proclaim one's own praise," and states that the Nahuatl word for gala-shields was *totopchimalli*. It is further evident from her researches that the ancient Mexican shields proclaimed their owner's achievements as effectually as the "coat of seas strown with palm-clad isles" granted to the great navigator, Columbus, the towns with spires and belfries" of the conquering Cortes, and the "augmentations" and "supporters" granted to the father and all the descendants of the African explorer, Captain John Speke — running water superinscribed "Nile," with a crocodile for crest, and a crocodile for dexter and hippopotamus as sinister supporters. As a modern example of recognition of noble achievements in the less adventurous paths of science we may cite the bizarre shield of Sir John Herschel emblazoned with the astronomical sign of the planet Uranus, "a forty-foot reflector," observer's house, and other paraphernalia. It may be added that the gruesome emblems portrayed on the shields borne by the chief-priestly warriors of the Aztecs were as significant of official functions as the mitre so often quartered in our episcopal arms.

Many of the heraldic emblems of the ancient Mexicans recall those of Europe — "the eagle's claw on an azure field borne by the sub-chiefs known as the "daring eagles," blue serpents on a red field, the tiger's leg shield the insignia of an order of chivalry carried only by the daring oceolotl or tigers a "crack corps" clad in oceolotl skins. There is the death's head shield of the "emperor" Tizoc, the allusive feather-pellet shield of the war-god, Huitzilopochtli, bearing reference to his mythical origin from a tuft of humming-birds' feathers; the shell on that of the hero-god, Quetzalcoatl, which reminds one of the three escallops quartered on the coat of Darwin. The cross, often quartered on the shield of Quetzalcoatl, was symbolical to the native mind of winds blowing from the four quarters of heaven. In Mexico, we are told, the gods were represented with emblematic shields. The rain-god, Tlaloc, with a water-lily on a green field, the death goddess with cross-bones on a red field. This is not altogether surprising for, in many instances, they were the deified chief-priests and supreme war-lords of bygone generations. In this connection we may recall the fact that coat-armor was assigned to the Saviour and the twenty six quarterings emblazoned on an escutcheon in Mayence cathedral, and also the coats "granted to ennoble" the disciples by European heralds. (1.)

There is Mr. H. H. Bancroft's authority for the statement that Montezuma bore into battle "a banner with the strange device" of an eagle with beak and claws of gold swallowing a serpent, on an azure field. This was perhaps the first instance of "spread eagleism" on the continent of America. It was emblematic of the myth concerning the foundation of the peublo of Tenochtitlan in the valley of Mexico, and the design still forms the national arms of the modern republic of Mexico.

Animal designs are of frequent occurrence, and, like many of those employed by European heralds, are just as great a puzzle to the bewildered zoologist as the live lions at "the Zoo" to that sceptical official of the Herald's College who said he had "tricked" too many lions in his day not to know the real animal when he saw it. One of the most remarkable of the Mexican emblems is that of the blue monster outlined in strips of beaten gold, rampant on a rose-red field of the beautiful feathers of the roseate spoon-bill (*Platalea ajaja*), the use of which was restricted to the decoration of idols and supreme rulers. This fine shield was rediscovered by Mrs. Zelia Nuttall last summer, preserved, with other objects, in a case labelled "Transatlantic and Oriental curiosities," in the castle of Ambras, near Innsbruck, in Tyrol, where it has found a home for the last three centuries. This historical shield has been clearly identified by her as that described in the Spanish Inventory of 1596, which formerly belonged to the Archduke Ferdinand of Tyrol, and as one of the shields presented by Cortes to the Emperor Charles V. It bears traces of the former existence of a fringe of the long tail-feathers of the Quetzal, the use of which was also restricted to supreme rulers in ancient Mexico. The device, which is accompanied by the native picture signs for fire and water, may represent either the blue oceolotl or the Ahuitzotl, a fabulous aquatic monster dreaded by the Mexicans. It bears a striking resemblance to the "heraldic wolf" of the twelfth and thirteenth centuries. The shield is certainly a gala shield, and could only have been used by a war-chief of the highest rank. It is the best preserved example extant, and, to quote the exact words of our authority, is "the only one possessing a valid, if shadowy claim, to be that shield of Montezuma, which documentary evidence proves to have once formed part of the famous collection of historical armor of the Archduke Ferdinand, nephew of Charles the Fifth."

Another shield of wood, inlaid with turquoise and shell mosaic, was also found at Ambras. Since attention was called thereto by a communication addressed by Mrs. Nuttall to the Anthropological Society of Berlin (*Zeitschrift für Ethnologie*, 1891, p. 485), this valuable relic has been removed to the Imperial Ethnographical Museum of Vienna, which also contains the historical piece of ancient Mexican feather-work which Mrs. Nuttall has elsewhere shown to be a royal diadem or head-dress of the time of Montezuma, although it was originally described as a standard or banner by the late Professor F. von Hochstetter, who first recognized its value and ensured its preservation.

The centre or boss of a second specimen of an inlaid turquoise mosaic shield is exhibited in the Christy collection in the British Museum, where it is named, on what authority is not known, a Mexican calendar; but Mrs. Nuttall is enabled to state from personal examination that it is not a calendar, and bears none of the symbols of the Mexican year. In all, Mrs. Nuttall's industry and acumen have resulted in the accumulation of figures or descriptions of hundreds of Mexican shields from native and Spanish sources. Not more than six specimens are actually known to be preserved in the museums of the world. Her researches throw fresh light on the status of the ancient Mexicans and their somewhat bizarre semi-civilization.

Colonel Garrick Mallery, in his interesting work on "The Pictographs of the American Indians," reproduces native representations of North American Indian chieftains on the "War Path," carrying shields bearing the *totem* of the tribe, a very useful distinction when different tribes unite in raiding, as we know to be still the custom. We believe, however, that Mrs. Nuttall's memoir on "Ancient Mexican Shields" records the first evidence of heraldic emblems borne in the western hemisphere "as boastful records of individual achievements." We are not aware that any evidence has been discovered of the hereditary use of heraldic devices in ancient Mexico, although there are frequent references in her various and important publications to native

genealogies accompanied by portraits of *pilhua* = the heads or founders of large families as found recorded in native MSS. It is more probable that in a state of semi-barbarism individuals had to earn and win their own distinctions. No hereditary surnames were in use among the Mexicans anterior to the Spanish conquest. It is stated in a recent treatise on European Heraldry[1] that some of the peasants of the Jura Mountains did not possess them so late as the Election of 1789. We learn from the same authorities that surnames did not come into general use in Europe until after the second crusade of 1147, which gave such an impetus to the bearing of coat armor and heraldic insignia in general. In this regard it is interesting to note that it was to the intertribal wars waged in Mexico solely for the purpose of securing human victims for religious sacrifices that we can trace the development of Mexican heraldry. The independent invention and use of heraldic insignia in the New World is but another proof of the truth of the dictum that human nature is very much alike all the world over.

Brighton, England.

GAY HEAD.

BY P. R. UHLER.

THE steady flow of modern travel has opened an easy way to the delightful island of Martha's Vineyard, where the socially inclined may enjoy the advantages of summer schools of science, or participate in the exercises of the camp-meeting within spacious and airy pavilions. Here the artist finds a prospect of varied color, with long vistas of cliff and sea and sky standing forth in surpassing loveliness and inviting an effort to place on canvas his richest and brightest tints.

To the student of nature, however, there is access to an ever-increasing store of facts. The more he investigates the structure of the region, with its assemblage of creatures and plants, or views the struggles of atmosphere, land, and ocean to maintain an equilibrium, the more he finds himself beset by perplexing questions, which will not be answered at his bidding. A riddle, as yet but partly solved, lies involved in that wonderful piece of earthy structure called Gay Head. Here, at the western extremity of the island rests a huge pile of sand, rock, and clay, more than one hundred feet high, tinted with numerous vivid colors, which have been the wonder and delight of the voyager ever since the discovery of the country. The sparse settlement of the island has as yet produced but a short chapter of the history of its people; but the record of nature's changes and disturbances, which have affected the land and sea, would fill large volumes.

To one series of these changes, belonging to its geology, we would now direct attention. The greater part of the island shows evidences of having been submerged five times beneath the waters. At each emergence from the water, an increased thickness was given to the body of the land, so that at the beginning of the last glacial period it stood on the western side at a level of not less than two hundred feet above the surface of the tide.

At the close of that period and chiefly remaining to the present time, a deep deposit of fine sand, boulders, gravel, and broken stones, from ten to twenty-five feet in thickness, covered the upper slope of the ridge. The Potomac Clay, which forms the inner and also the lowest descending division of the deposits resting here, rises like a central core to near the summit of this hill. As most of the other members below the glacial deposits are either absent from, or only feebly represented on, the upper surface of the clay, a thin bed of sand and other glacial material forms the superficial covering. On both slopes of this ridge, the west and the east, the column of geological formations is present, although not in fully unbroken continuity, the Cretaceous Green-Sand Marl having not been found on the eastern slope by the writer. On this side, however, the Raritan Formation, previously defined in Maryland as the Alternate Clay-Sand group, displays an exceedingly fine exposure, with the strata and laminated layers in original order. Here, also, it is enriched with the same plant fossils and lignitic wood so characteristic of these beds on the Raritan, Severn, Magothy, and other rivers of New Jersey and Maryland.

No evidences of mountain-folding appear in any part of the elevated division of the land. The underlying member which descends deep below tide, is the Variegated Potomac Clay, and this forms the foundation for all the other formations in their usual order of superposition.

Deep denudation and erosion followed the completion of the Potomac Clay, and it was cut to below the line of present low tide at the localities now occupied by Menemsha, Squibnocket and Nashaquitsa ponds. The broken surface of this clay and the presence of the Raritan and other beds above it on the low hills of Menemsha Bight, show how deeply the Potomac formation was here degraded before the next succeeding formation was laid down. Consequently in early Cretaceous time a high plateau of the clay was carved into sloping reliefs which had their most depressed surfaces spreading away towards the east and south.

The steep side of the island is on the west, and here it is that the modern surf has cut away large tracts of the ancient bluff. On the Gay Head division the sea has been digging away the cliffs at the rate, it is said, of sixteen to twenty feet in a year. The stretch of boulders called the Devil's Bridge, lying at a distance of fully half a mile from the present beach, shows where the outer border of the bluff formerly stood. The Potomac Clay not only extends out that far at the bottom of this shallow shelf of Vineyard Sound, but we are told that it sticks to the anchor in the channel which now runs on a course more than two miles distant from the present beach. A searching survey ought to show that this clay underlies the Elizabeth Islands and stretching away south-west passes under the borders of the mainland of Massachusetts and Rhode Island, and from thence under Long Island and Staten Island to beneath the lower clays of New Jersey.

The section as it is now exposed in the less-disturbed bluffs of Gay Head shows the Variegated Clay near the beach in strata or arched beds from three to more than ninety feet in thickness. The undisturbed upper part of this member is sometimes a whitish or red clay, and is often more or less mixed with sand.

Immediately above this, but not on the summit of the clay, rests the group for which we now offer the name Raritan Formation, from the river on the shores of which it is so extensively exposed. It consists of a few feet of brown, coarse sand at base, which is sometimes indurated into a moderately coherent sandstone. Above this is a bed, two or three feet thick, of white sand locally streaked with white clay. Over this the laminated sands, black and gray, charged with lignite, and parted with fine white sand, rise up into thin layers of a paler clay which alternates with seams of the white sand. This clay appears more massive in some sections of the bluffs, and occasionally forms a homogeneous stratum, from three to five feet thick. Next above this is a most conspicuous stratum of disintegrated granite, which is a kind of coarse rock-flour, white on the weathered surface, but gray in the covered mass. It forms a bed ranging from ten to more than fifteen feet in thickness. This forms the superior member of the group, while the whole Raritan Formation, as here recognized, reaches a maximum thickness of about fifty feet.

Next higher in the bluffs rest the ferruginated remnants of the Cretaceous Green-Sand Marl. The great body of this deposit has slipped down or been overthrown upon the steep side of the cliff facing Vineyard Sound. It appears in three separate piles, stretching from near the summit of the projecting buttresses down to the beach. The only part of it now remaining near the line of its original position is represented by a few inches of altered brown sand, in patches. These are the vestiges of the thin edge of the stratum which stretched out towards the sound, and which terminated in a bed eight to ten feet thick in modern time. Eighty or more feet outwards it is a thick body of dark-green

[1] A Treatise on Heraldry: British and Foreign. By John Woodward, F.S.A., and the late George Burnett, LL.D. (Lyon King at Arms). W. & K. Johnston, Edinburgh, 1891.

sand, resting in one place on end, and much mixed on the surface, sides, and end with gravel and fossils belonging to later formations. Bones of whales and fragments of shells of the Miocene Formation have settled into its broken surface; but in the unmixed interior of the mass, it has yielded to me soft casts of *Gryphea* and *Cucullea*, hard fragments of the bones of reptiles, with coprolites, and teeth of the shark *Otodus*. The component materials of this marl agree with those of the Lower Marl of New Jersey, and, like the latter, rest directly upon the upper member of the Raritan Formation.

The Miocene Formation, so far as my own observation extended, is broken up, and so mixed with the drift at the base of the glacial deposits near the surface that the only evidence of its former presence here, below the belt of conglomerate, resides in the presence of vertebræ of Cetacea, fossil shells, and some teeth of sharks.

On the surface is the fine pale sand, forming a loose bed, underlaid by about two feet of pebbly conglomerate which rests in a bed of broken rocks, gravel, and boulders. The sand is spread thickly over most parts of the island, and along the western ridge it is set with granitic boulders measuring occasionally twelve feet in length and width by six to eight feet in thickness.

The whole Gay Head promontory is a scene of disturbed equilibrium, where the beds of rock-derived material have been softened by atmospheric agencies, pressed down by a load of stone and gravel, undermined by oceanic strokes of oceanic surf, and let down into gullies by trenching storms of rain.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

A Mountain-Top Experience.

FREMONT PASS, Colorado, is 11,540 feet above the sea. To the east rises a peak by a rather steep slope, perhaps 2,000 feet higher. Its eastern slope is precipitous.

On Aug. 18, alone, I reached the summit of this peak. It was noon. Several miles away to the north a heavy thunder-storm was raging, while far to the west was another. Within a mile or two a massive cloud had formed between the lower mountains which shut in a gorge. I stepped to the very highest point of the peak. My contemplation of the extraordinary view afforded me was disturbed by a sharp buzzing as of bees seemingly beneath my hand which rested on the bulky pine sliver serving as my staff. But on lifting my hand I found no bees large or small.

As the buzzing continued, I vainly scrutinized the stick for signs of life. I then indifferently concluded that it was possibly caused by some boring insect in the wood. That settled (?), I lifted a large roundish rock to toss into the chasm below, when it, too, buzzed or crackled in my hand at a score of points. Close inspection revealed no bees or bugs on that rock. Can it be. I asked, that this rock is crackling from the change of temperature occasioned by a change of position? At that moment, the "bees" were swarming in my hat. Snatching it off, I was searching it for the buzzing things when they seemed to throng my hair. Immediately on raising my hand to my head the puzzling mystery was solved, as the strong flow of electricity fairly tingled and buzzed through my fingers, and, looking up, I saw a cloud forming overhead. I was acting as a lightning-rod to that mountain-peak. Ignorant of my possible safety or danger in the involuntary experiment, I lacked the valor or scientific devotion to prolong it. Securing my box of flowers and that buzzing staff, I discreetly retired some distance down the slope from that summit surcharged with possible electrocution if I remained. Ere I reached the pass, two hours later, the storm from the north had reached the peak, and soon that rocky summit was whitened with snow, while hail and rain fell in the pass.

During my descent, while the thunder-cloud rapidly approached the peak, a strong wind blew through the pass directly toward the cloud until light rain began to fall. Is my experience as given a common one? Was it a dangerous one?

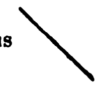
O. C. CHARLTON.

Denton, Texas.

The Gemination of the Lines in Mars.

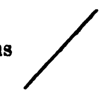
As far as one can judge from newspaper reports, the recent observations on Mars render certain the existence of the curious Schiaparelli lines, but as yet nothing has been seen of the doubling, or gemination, which has been claimed. If this negative result shall be sustained by the accounts yet to come from observatories in lower latitudes, there still remains the interesting question, How did such a mistake come to be made?

A bit of personal experience will, I trust, be pardoned, since it points to what seems to me the explanation of the error, if one exists; at least, it shows the existence of a *vera causa* able from single lines to produce double ones. The lens in my left eye possesses the power of double refraction. If I close the right eye and look at a line drawn obliquely, thus



No. 1.

the paper being held squarely in front of me, I see nothing peculiar; there is to me, as to anyone else, only one ordinary black line. But if the line slopes thus



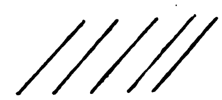
No. 2.

I see two lines

No. 3.

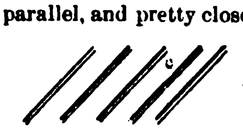
the lower one being decidedly less deeply black than the other. As I now hold the paper, the bottom towards me, No. 1 appears as a single line, No. 2 as a double one, like No. 3. If now I turn the side of the page towards me, revolving it through an arc of 90°, No. 1 shows double and No. 2 single.

If I draw a set of single lines as below



No 4.

and look at them with both eyes, or with my right eye alone, I see only so many single lines; but if I close my right eye, then with my left I see ten lines, each original line being geminated by a fainter one exactly parallel, and pretty close to it, as in No. 5.



No. 5.

If now I turn No. 4 to the right or left, the double images will approach each other, and at the same time slide by each other a little until I have turned the paper 90°, when the images will coalesce, each line appearing sharply defined, single, and very black, except at each end, where for about $\frac{1}{16}$ of an inch the color will be fainter and the line less sharply defined. I can vary my experiments in many ways, each time getting the well-known phenomena of double refraction.

The application to the lines in Mars is very simple. If a person possessing an eye with this power should see the planet's image in the telescope, and be able to perceive the Schiaparelli lines, he would see each accompanied by a twin line of the same length, but not quite so sharp and distinct. If the lines ran, as in No. 1, from north-west to south-east, he would not see the secondary ones, but if his other eye chanced also to have a double refracting lens with axis at right angles to the first, he would then see the secondary lines in the same way.

I know, from my own experience, that one may possess this power without being conscious of it. I discovered it only when experimenting on single vision. In ordinary use (i. e., with both eyes) I cannot perceive any indication of it, the greater illuminating power of the ordinary ray, plus that of my other eye, com-

pletely conceals the secondary image. I have no doubt that if I should look at Mars through an instrument powerful enough to show the single black lines, I should rediscover the twin line of each, that is, if I used the polarizing eye.

I presume others have noticed this power in themselves, or discovered it in other persons, but I have not happened to come across such. One can easily test his own eyes, by making a fine black dot on a piece of white paper and examining it with one eye at a time. If he possesses this power, he will see two dots pretty close together, one much darker than the other. Then let him revolve the paper; the paper will go around, but the dots will retain their relative position. If, for example, the secondary dot is to the right of the other, it will stay to the right, however much the paper is turned. It may be necessary to move the paper nearer to or farther from the eye, but if the double-refractive power is there, it will soon be found. C. B. Warring.

Park Lupin, Aug. 29.

The Aurora of July 16.

The various accounts of this aurora which have come to my notice contain no mention of a band or curtain formation. They all agree in describing the aurora as simply an arc of light, with well-marked streamers of more or less brilliant coloring. I append a description of an appearance, not already noted, which was observed by me in Mechanicsburg, Pennsylvania.

The day had been cool and fair, and after sunset only a few clouds could be seen in the north. About nine o'clock a faint auroral arc was visible, and later a brilliant white ray shot out from the north-west and extended beyond the zenith. Nothing more of note occurred for an hour. By this time the clouds had disappeared, with the exception of two small stratified bands, which hung low in the north. They were parallel with a narrow opening in line with the horizon. At 10.15 this space became brilliantly lighted, the color changing between green and pink. Then from the eastern edge of the space a brighter and intensely green light spread rapidly westward, and apparently descended from between the clouds, assuming the shape of a band in folds or waves like a banner in a breeze, as those who have seen this appearance in more northerly latitudes describe it. When the band became well defined, it grew stationary and the green light increased in intensity; and then occurred a magnificent electrical display. From the upper edge a bright pink light suffused downwards until it almost overspread the curtain, when it paused; and for a few seconds there was presented a pink banner, edged with a regular but narrow border of bright green, in stationary folds or waves. Yet there was no progressive wave-motion observed, as seems common to this phenomenon. The formation was repeated after a time, but very indistinctly. As nearly as could be estimated, the entire occurrence could not have lasted more than ten seconds. W. M. Stine.

Athens, Ohio.

The Ancient Libyan Alphabet.

In *Science*, Aug. 19, Dr. Brinton treats my equation of *Finagh* with *Phœnician* as "fanciful," and traverses my assertion that the stress falls on the root *fin*. The equation may be fanciful, but the assertion, stigmatized as "utterly incorrect," is absolutely true. Dr. Brinton says that the stress "falls on the last syllable, and not on the penult (see Hanoteau, 'Grammaire Tamachek,' p. 5)." From this the reader might suppose that the French scholar was on Dr. Brinton's side, and accented the word on the last syllable. Such is not the case. Hanoteau does not accent the word at all, makes no remark on its accentuation, and in his grammar nowhere refers to the question of accent. It is Barth, a supreme authority on a point of this nature, who always accents the word on the penult, as already stated by me. What Dr. Brinton appears to have mistaken for an accent in Hanoteau (p. 5) is not an accent, but a diacritical mark used by him to distinguish the "r grasseyé" answering to the Arabic *ghain* from the soft *r* (*r'* and *r*), and in the same way to distinguish the deep guttural *k* (*q*) answering to the Arabic *qof* from the ordinary *k* (*k'* and *k*). Hence he writes *tifinar'*, the mark falling, not on the final vowel *a*, but on the final consonant *r*, which he means to be pronounced as with the Northumbrian *burr*, or like the Arabic *ghain* (tifinagh, as Barth always writes it, and always accenting the *i* of *fin*, thus, tifínagh).

It is strange that Dr. Brinton should have at all ventured to take up my reference to Hanoteau, for on the main issue Hanoteau is dead against him, writing that "le système d'écriture des Imouchar' [Sahara Berbers] est analogue à celui des Arabes et des Hebreux" (p. 1). In other words, it is Semitic. But doubtless the passage has escaped Dr. Brinton's notice. As to Dr. Collignon's cock-sure assertion that it is "antérieure à Carthage" and that "it is time to discard" the theory of its Punic origin, it will suffice to say that, if it comes to the *ipse dixit* argument, the name of Mommsen alone will outweigh fifty thousand Collignons.

Lastly, touching the squares and the rounds, otherwise a point of secondary importance, unless you have a theory to serve, my reference should rather have been to Hanoteau's "Grammaire Kabyle" than to his "Grammaire Tamachek." It is in the former work (p. 360) that is given the full table of the three variant Berber alphabets, with the following results: I. Five curves; six rectangular forms; two acute angles. II. Seven curves; five rectangles; two acutes. III. Six curves; five rectangles; three acutes.

And here the matter may rest, as Professor Newman needs no rehabilitation from me, and in any case cannot be held responsible for the incapacity of "French scholars" to assimilate his "phonetic system." A. H. Keane.

79 Broadhurst Gardens, South Hamstead, N.W., Sept. 7.

BOOK-REVIEWS.

Life Histories of North American Birds, with Special Reference to Their Breeding Habits and Eggs. By Charles Bendire. Washington, Government. 554 p. 4°. Ill.

The Humming Birds. By Robert Ridgway. Washington, Government. 131 p. 8°. Ill.

The publications of the Smithsonian Institution and of its offspring, the U. S. National Museum and the Bureau of Ethnology, are becoming almost too numerous to be kept track of by any but the professional librarian. Ordinary readers have long since despaired of the task, and consider it as a matter of course that they will seldom or never hear of them all, to say nothing of the pleasure of seeing them. True, many of these publications are of such technical character that only specialists care for them, and these are supposed to be cognizant of the publications pertaining to their study. On the other hand, there are many papers published by the Institution of great general interest, and it frequently happens that these are largely inaccessible to the general public. Any retrospective view of the work of the Smithsonian from its inception deals almost exclusively with its publications. These, beginning with meagre annual reports, containing administrative and financial statements, have increased so in numbers and variety that it requires a good-sized volume to catalogue them. It is the intention here to refer to them in only the most general way.

At the present time they may be grouped under three heads: 1. Those of the Smithsonian proper; 2. those of the U. S. National Museum; and 3, those of the Bureau of Ethnology. Under the first of these we have (*a*) annual reports; (*b*) miscellaneous collections; (*c*) contributions to knowledge. Under the second we have (*a*) annual reports; (*b*) proceedings; (*c*) bulletins; and (*d*) special bulletins. Under the third come (*a*) annual reports; (*b*) contributions to North American ethnology.

To still further complicate matters and bewilder the enquirer, we find that frequently there are several editions of these volumes, one always appearing in the guise of a congressional document, and another in the form designed for general distribution. Besides this, it has of late become the habit, perhaps from the necessities of the case, to issue, under a separate cover, papers which may appear in various annual reports or proceedings.

The first few annual reports of the Board of Regents of the Smithsonian contain few or no papers of any great general interest. It was not many years, however, before these began to appear in an appendix to the administrative report. During the latter part of Professor Baird's administration a special feature

was made of general summaries of the progress of science. Within the past few years these have been discontinued, and there is a return to the old plan of placing in an appendix papers having special value. Further, since the National Museum has fairly begun its work, the annual report has been swelled far beyond the compass of one, and so is now issued in two volumes. One of these is devoted to the Smithsonian, and the other to the Museum. The annual reports and other publications of the Bureau of Ethnology will not be considered here.

The second series of publications of the Smithsonian is the "Miscellaneous Collections." In this are given papers which are the results of original investigation, and which are too long to be included in the annual reports. The volumes are in octavo form, and some of them, like Gray's "Synoptical Flora of North America," contain from 900 to 1,000 pages. There are now about 35 volumes in this series. The third series, "Contributions to Knowledge," is in quarto form, and includes many elaborate and finely illustrated monographs. Among them are Squier and Davis's "Ancient Monuments of the Mississippi Valley," Wood's "Fresh-Water Algæ," etc. There are about 25 volumes in this series.

Of the publications relating to the work of the U. S. National Museum, the annual reports have already been referred to. Papers in these admit of considerable elaboration, but are not considered extensive enough to be published in separate form except as excerpts, which is the case with the second of the books given in our title. When it became apparent that the results of the work of the curators of the Museum would be too long delayed if issued in the annual reports, the "Proceedings" of the Museum was established. This contains advance notices of work, with preliminary descriptions and short notes, which could find no place in other series of the Institution. It is now in its fifteenth volume, but it is published in so small an edition that it is only rarely seen outside of public libraries. Excerpts from it, however, are frequently distributed to specialists. In 1875, previous to the establishment of the "Proceedings," there began to appear a series under the name of "Bulletins." These are octavo in form, and consist of long and elaborate monographs of various orders, or catalogues of birds, beasts, or plants. There are now some 39 of these Bulletins.

Finally, a new series of "Special Bulletins" in quarto form has been begun. Of this series, the volume which forms the first portion of our title is No. 1. The author, Capt. Bendire, is the curator of oölogy in the museum, and he gives in the volume descriptions of the breeding habits of gallinaceous birds, (partridges, grouse, etc.), pigeons, doves, and birds of prey. The nomenclature followed is that of the American Ornithologists' Union Check-list. There is no attempt at synonomy, only the original and the latest name being given. The geographical range for each is also given. In the text there is no description of the bird itself, but the breeding habits, food, nest, and eggs are all fully described. This information has been derived from original notes, from private correspondence, and from published statements. Many interesting facts are given, and a few extracts will serve to show the rich store it contains. The following account of the dance of the prairie sharp-tailed grouse of Manitoba is quoted from the unpublished notes of Mr. E. E. Thompson:—

"After the disappearance of the snow, and the coming of warm weather, the chickens meet every morning at gray dawn, in companies of from six to twenty, on some selected hillock or knoll, and indulge in what is called a 'dance.' This performance I have often watched, and it presents the most amusing spectacle I have yet witnessed in bird life. At first the birds may be seen standing about in ordinary attitudes, when suddenly one of them lowers its head, spreads out its wings nearly horizontally and its tail perpendicularly, distends its air sacs, and erects its feathers, then rushes across the 'floor,' taking the shortest of steps, but stamping its feet so hard and rapidly that the sound is like that of a kettle-drum; at the same time it utters a sort of bubbling crow, which seems to come from the air-sacs, beats the air with its wings and vibrates its tail, so that it produces a loud, rustling noise, and thus contrives at once to make as extraordinary a spectacle of itself as possible. As soon as one commences, all join in, rattling, stamping, drumming, crowing, and dancing together furiously; louder and louder the noise, faster and faster the dance becomes, until at last, as they madly whirl about, the birds leap over each other in their excitement. After a brief spell the energy of the dancers begins to abate, and shortly afterward they cease, and stand or move about very quietly, until they are again started by one of their number leading off. . . . The space occupied by the dancers is from 50 to 100 feet across, and, as it is returned to year after year, the grass is usually worn off, and the ground trampled down hard and smooth. The 'dancing' is indulged in at any time of the morning or evening in May, but it is usually at its height before sunrise. . . . When the birds are disturbed on the hill, they immediately take wing and scatter, uttering as they rise their ordinary alarm note, a peculiar vibrating 'cack, cack, cack.' This is almost always uttered simultaneously with the beating of the wings and so rarely, except under these circumstances, that at first I supposed it was caused by the wings alone, but since then I have heard the sound both when the birds were sailing and when they were on the ground, besides seeing them fly off silently."

One of the dangers of egg-hunting in the western wilds is given in an account of the zone-tailed hawk. One day, while riding up Rillitto Creek, in Arizona, Capt. Bendire observed one of these birds fly from its nest, and he determined to examine it. "Climbing to the nest," he says, "I found another egg, and at the same instant saw from my elevated position something else which could not have been observed from the ground, namely, several Apaché Indians crouched down on the side of a little cañon which opened into a creek bed about eighty yards further up. They were evidently watching me, their heads being raised just to a level with the top of the cañon. In those days (1872) Apaché Indians were not the most desirable neighbors, especially when one was up a tree and unarmed. I therefore descended as leisurely as possible, knowing that if I showed any especial haste in getting down they would suspect me of having seen them; the egg I had placed in my mouth as the quickest and safest way that I could think of disposing of it, — and rather an uncomfortably large mouthful it was, too, — nevertheless, I reached the ground safely, and, with my horse and shot-gun, lost no time in getting to high and open ground. . . . I found it no easy matter to remove the egg from my mouth without injury, but I finally succeeded, though my jaws ached for some time afterward."

The author puts in a number of good words for the much-abused owls, considering that, as a rule, they are more useful to the farmer and poultry-raiser than harmful. This is especially the case with the barn owl, barred owl, screech owl, and burrowing owl. The great horned owl, on the contrary, is destructive, and merits the condemnation generally accorded it. Domestic fowls and game birds are killed by it in quantities, besides which it feeds upon various mammals, such as rabbits, squirrels, skunks, muskrats, etc. The account given of the burrowing owl disposes of the story that the bird lives in harmony with the prairie-dog and the rattlesnake, and the following extracts are thought to be of interest sufficient to quote:—

"A good deal of nonsense has found its way into print about the life-history of this owl; and the sentimental story of its living in perfect harmony with prairie-dogs and rattlesnakes, both of which inhabit a considerable portion of the range occupied by these owls, was for years accepted as true, and furnished the ground-work for many an interesting tale. . . . From an extended acquaintance with the habits of the burrowing owl, lasting through a number of years' service in the West, I can most positively assert, from personal experience and investigation, that there is no foundation based on actual facts for these stories, and that no such happy families exist in reality. I am fully convinced that the burrowing owl, small as it is, is more than a match for the average prairie dog, and the rattlesnake as well; it is by no means the peaceful and spiritless bird that it is generally believed to be, and it subsists, to some extent, at least, on the young dogs, if not also on the old ones.

"In Washington, Idaho, and Oregon they appear to migrate about the beginning of November, and sometimes earlier, returning to their summer homes in the early part of March. At any

rate, without actually examining their burrows during the winter months to ascertain their presence, I never saw one of these birds, as far as I can remember, sitting in front of these at such times, and I have lived where they were very common, and would certainly have noticed one occasionally if actually about. . . . These birds are diurnal in their habits, and may be seen sitting in front of their burrows at any hour of the day. When not unduly molested, they are not at all shy, and usually allow one to approach them near enough to observe their curious antics. Their long slender legs give them rather a comical look, a sort of top-heavy appearance, and they are proverbially polite, being sure to bow to you as you pass by. Should you circle around them, they will keep you constantly in view, and, if this is kept up, it sometimes seems as if they were in danger of twisting their heads off in attempting to keep you in sight. If you venture too close, they will rise and fly a short distance, and generally settle down near the mouth of another burrow close by, uttering at the same time a chattering sort of note, and repeat the bowing performance. Occasionally, when disturbed, they alight on a small sage bush; probably to get a better view of the surroundings.

"They hunt their prey mostly in the early evening and throughout the night, more rarely during the day-time. As soon as the sun goes down they become exceedingly active, and especially so during the breeding season. At such times they are always busy hunting food, and go and come constantly, and they may often be seen hovering suspended in the air, like the sparrow-hawk, locating their prey, or darting down noiselessly and swiftly, and grasping it with their talons without arresting their flight an instant. The actual amount of food a pair of these birds require to bring up their numerous family, generally averaging eight or nine, is something enormous. Each owl will eat fully its own weight in twenty-four hours, if it can get it. . . . As nearly all the food used by them consists of noxious vermin, it readily appears what an immensely beneficial bird the burrowing owl is, considered from an economic point of view, and deserving of the fullest protection.

"In southern California the burrowing owl commences laying about the beginning of April; in Oregon, Washington, and Idaho, rarely before the fifteenth of the month, and usually about the latter part of it; in Kansas and northern Texas, it begins about the same time; in Utah, fresh eggs have been found as late as June 15, and at Fort Collins, Colorado, on July 1.

"Although incubation does not appear to begin until the clutch is nearly completed, I have always found one of the parents at home, even if there was but a single egg in the nest. The old bird is courageous in the defence of its domicile, and, as a rule, will not leave it, although the way may be left clear for it to do so. Backing up to the extreme end of its burrow, it will strike with beak and claws in defence of its nest. Frequently, when within a foot or two of the nest proper, and before it was yet visible, the occupant made a rattling noise, produced by the rapid movement of its mandibles, which sounded very much like the warning of the rattlesnake when disturbed; this would easily impose on the average investigator, and, proceeding out of the burrow somewhat muffled and subdued, it is very similar indeed to the rattle of the latter."

There are 146 species described in the volume. Illustrations of the eggs of 94 of these are given on 12 beautifully colored lithographic plates. In looking over them, it is noticeable that, while the eggs of game birds and birds of prey are variously speckled and mottled, those of doves, pigeons, and owls are uniformly white. The last generally nest in holes in trees or similar places and are not conspicuous by reason of this color. The eggs of doves and pigeons, while placed in open nests, are screened by the parent birds, which are protectively colored. Grouse and other game birds generally lay their eggs on the ground, where their mottling prevents their being conspicuous; white birds of prey have similarly marked eggs, which may be considered as protectively colored also. The book contains a great mass of interesting information which will be welcomed both by ornithologists and the ordinary lover of birds. One cannot but regret that the index

Publications Received at Editor's Office.

CANADIAN GEOLOGICAL SURVEY. Annual Report for 1888–89. Ottawa: S. E. Dawson. 8°. Paper.

COMMISSIONER OF FISH AND FISHERIES. Report on the Establishment of Fish-cultural Stations. Washington: Government. 4°. Paper. 88 p. Ill.

HAY, O P. On the Breeding Habits, Eggs and Young of Certain Snakes. Washington: Government. 8°. Paper. 13 p.

——On the Ejection of Blood from the Eyes of Horned Toads. Washington: Government. 8° Paper. 9 p.

HOWARD, L. O. Insects of the Sub family Encyrtinæ with Branched Atennæ. Washington: Government. 8°. Paper. 9 p.

STEJNEGER, LEONHARD. Two Additions to the Japanese Avifauna. Washington: Government. 8°. Paper. 8 p.

TORREY, BRADFORD. The Foot-Path Way. Boston: Houghton, Mifflin & Co. 12°. 245 p. $1.25.

U. S. NAVAL OBSERVATORY. Meteorological Obserservations and Results, 1888. Washington: Government. 4°. Paper. 60 p.

——Magnetic Observations, 1891 Washington: Government. 4°. Paper. 100 p.

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A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

is so defective. The authorities quoted from or referred to are frequently mentioned, but there are innumerable cases where they are not. It thus becomes an impossibility to ascertain from the index whose work has been and whose has not been referred to.

The second title mentioned in our heading pertains to a paper of quite a different character from the foregoing. The first is a bulletin in itself, the second is an excerpt from the annual report of the U. S. National Museum for 1890: the one treats of special features in the life of birds, the other discusses in general and particular the characters of a small group. In this monograph on humming birds the author, Mr. Robert Ridgway, gives an interesting account of these wonderful little creatures. Among the many subjects discussed, we find an account of the early history of the literature of the group; remarks on the geographical distribution of the species; mention of their habits, manner of flight, migrations, intelligence, nests and eggs, food, variations, etc. The last 70 pages are devoted to descriptions of the species occurring in the United States, seventeen in all, of which illustrations are given of all but five. There are many other figures, some of which are original and others copied from Gould's "Monograph of the Trochilidæ."

The family is essentially one of the New World, not a single species being known outside of its bounds. Their diminutive size and brilliant coloration have made them favorites with ornithologists, and, as in the case of every other well-studied group, innumerable genera and species have been made. Dr. Coues refers to this fact, and notices that it was carried to such length that it finally reached "the farcical and scandalous extreme of some 350 genera for few more than 400 known species." In size the species vary from about 8½ inches long to only 2¼ inches. Notwithstanding their smallness, they are capable of the most rapid flight, and some perform journeys of 2,000 miles in their semi-annual migrations. On the west coast the highest latitude attained is in Alaska, about 61°, by the rufous-backed hummer, which is found in winter in Mexico, more than 2,000 miles to the southward of its summer station. In the eastern United States the common ruby-throat ranges in summer as far north as 57°, and in winter is not known to occur north of southern Florida (latitude 29°), while its most southern limit is on the Isthmus of Panama, only 8° north of the equator. Species are most numerous in mountainous countries where there is great diversity of soil and productions within small areas. The State of Ecuador has 100 species within its borders, more than one-half not occuring elsewhere. Mr. Ridgway says regarding their geographical distribution: "Their centre of abundance is among the northern Andes, between the parallels of 10° north and south of the equator, from which region they gradually diminish in numbers both to the northward and southward, but much more rapidly toward the extensive lowlands of the eastern portion of the continent. The northern limit of their abundance may be approximately given as the Tropic of Cancer, beyond which but few of the fifty Mexican species extend, while only eighteen of them have been detected across the boundary line in the equally mountainous portions of the south-western United States, including the semi-tropical Rio Grande Valley. Small as this number may appear, the south-western portion of the Union may be considered richly endowed compared with the vast valley of the Mississippi and the Atlantic water-shed, a region of unsurpassed fertility and luxuriant vegetation, yet which throughout its whole extent, even including the peninsula of Florida, possesses only a single species of humming bird!"

The usefulness of this monograph would be greatly increased by the addition of a table of contents and an index. Neither of these is present in the excerpt, a though they are probably provided for in the report from which it is taken. One must turn page after page to find remarks upon any special subject. Notwithstanding this, however, readers must be grateful to Mr. Ridgway for the work he has done. JOSEPH F. JAMES.

Washington, D.C., Sept. 16.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

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N. D. C. HODGES,
874 BROADWAY, NEW YORK.

TO THOSE INTERESTED IN SCIENCE.

[Science (weekly) established in 1883, N. D. C. HODGES, 874 Broadway, New York City.]

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
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Bird on Its Nest, The.
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Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
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Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
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Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, New Method of Protecting Buildings from.
Lion Breeding.
Lissajou's Curves, Apparatus for the Production of.
Maize Plant, Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
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Weeds as Fertilizing Material.
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Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

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SCIENCE

NEW YORK, SEPTEMBER 30, 1892.

THE EFFECTS OF CIVILIZATION ON OUR BIRDS.

BY MORRIS GIBBS, M.D.

In scanning the notes of any reliable observer, in the ornithological field, of twenty years' standing, one of the most noteworthy features presented is found in the many allusions to the frequency or infrequency of various species formerly abundant or unknown. We find numerous notes like this: "Seldom seen; formerly abundant," or, more rarely, "common; exceedingly rare years ago." These conflicting notes are of peculiar interest to everyone in any way concerned in the welfare of a community, and cannot fail to excite speculation among those who have noted the changes. The changes, either gradual or sudden, have resulted from natural or unnatual causes in many and devious ways. Unnatural is a word perhaps improperly used here, even allowing that civilization has eradicated many species from the globe. We had best look at man only in the light of an animal when we are to compare him in nature, and we can but acknowledge that the civilized state is simply in advance, and, in which we are simply better adapted to perform the work of extermination or cultivation.

It is easy to account for the appearance or disappearance of some species, and, with many, the reasons assigned are so self-evident that the generally accepted theories are rarely disputed. With our game birds, it is duly acknowledged by all capable of reasoning that the cause of the disappearance, as in the case of the wild turkey, *Meleagris gallopavo*, from well-populated districts, is entirely due to persecution by the gunners. However, there are many cases of unlooked-for changes; increase or decrease of numbers, for which we are not fully able to account. The writer, having carefully studied the subject for ten years, and with the assistance of nearly a quarter of a century of his own observations, feels confident in presenting some conclusions. These deductions may not be correct, but may at least promote investigation and inquiry into the subject by others more capable of explaining.

The causes of local change, in scarcity or abundance, as regards animal life, varying migrating routes, and ultimate disappearance, or other reasons, are many and peculiar, but may, I think, be grouped collectively under the following two heads: —

I. Natural causes, or features arising from other causes than those resulting from civilization. These are many, so far as we are able to judge, but are hardly to be considered here. They come under that division normally included in the evolutionist's province.

II. Unnatural causes, or those changes occurring from causes aside from the direct effects of nature; that is, more through the direct effects of civilization. These various changes may be discussed under the following divisions; remembering always that the system, as a whole, depends on the changes resulting from man: —

a. — Proximity of the habitations of man.

b. — Removal of forests and general clearing of vegetable growth.

c. — Drainage of land.

Under the first heading may be considered the most serious incursions in the ranks of our feathered neighbors, as it is chiefly due to the nearness of sportsmen and unsportsman like individuals, as well as to the demands of milliners and the small and reasonable wants of scientists and collectors, that the birds, game, plumaged, and song, are principally sought. In addition to these well-known causes for total disappearance, or great diminution in numbers, we may add many hundreds of causes that contribute in a greater or less measure towards this end. Anyone of an observing turn must have noticed the multitude of ways which help towards decimation. A few causes may be mentioned from the innumerable series to only suggest the dangers of proximity of the habitations of man. The light-houses of our great lakes and coasts kill many thousands each year, and perhaps hundreds of thousands, the birds killing themselves by dashing against the lights when migrating seasonally. It may well be doubted if there exists an invention, with the exception of the gun, more deadly to the birds than the electric light. Then there is the head-light of the locomotive, and the very destructive telegraph and other wires, which form a net-work throughout the country. In fact, there is hardly a cause from which man himself dies, through accident or design, which does not likewise destroy our birds. Hanging, drowning, and cremation are not rare causes of their taking off. Fires in particular are damaging means each year, particularly when occurring in wild half-clearings, stubble-fields, and virgin forests, in the spring and summer; but perhaps the most destructive fires are those that ravage large prairie sections where the prairie species nest. Without a doubt, early settlers, both in wooded as well as prairie lands, are guilty of a fearful devastation to both song and game birds in their efforts to clear up and improve the land.

As far south as I have been in the United States, and our line extends nearly to the tropics, and on the north to Lake Superior, I have met with plumage collectors for the "dear ladies'" wants. The blue-jay, tanager, and oriole cannot migrate too far north in our land to escape persecution in behalf of that travelling side-show, the feminine head-gear, and no matter where you go in the south, if it is in the everglades of Florida, you will find the plume-hunter busy for the almighty dollar, which he frequently gathers by shooting the parent birds at their nesting-sites, leaving the squabs to starve in their nests. One man (?) told me that he had shot two hundred white and snowy herons at one rookery in southern Florida; and this all for the money paid by vain, self-adorning women. Perhaps I have said more than is required on this subject, but many will not think an excuse necessary.

It is hardly worth while speaking of the destruction of game and other birds by the gun, net, and trap, as these methods of extinction have been so thoroughly canvassed that they are at least understood by all reasonable men. The havoc made on our wild pigeons with the set net is well known, and the sentiment is voiced by all that we would still have plenty of pigeons had the nets not been used, contrary to law, near the breeding-grounds.

Although so many species are noticeably diminished in numbers through the advent of advancing civilization, there are a number of birds which have become much more abundant, and a few even which have become residents or occasional or annual visitors, which were formerly not found in this section. Among them, here in Michigan, the most remarkable are in the cases of the robin, crow, black-throated bunting, meadow lark, orchard oriole, and turkey buzzard. All of these species were unknown near Kalamazoo in 1832, though they may have been recorded from the vicinity of Detroit, which was a much older settlement. About the year 1835 the robin appeared, lured hither by the social relations which have ever existed between civilization and these pleasing birds. The crow did not arrive till 1850 or later, and was not common till 1875, yet now it bids fair to become as great a nuisance in our State as it has proven in the East. The old settlers assert that the orchard oriole and meadow lark were not here at an early day, and though we cannot attest when they did first appear, we are convinced that it is through the influence of civilization that they are so abundant now. In this, Kalamazoo, county the black-throated bunting was unknown twenty years past, yet the notes *dick sissel sissel* may now be heard from almost

every clover-field, in June, in Michigan, south of 43 degrees. About 1870 a specimen of the turkey buzzard was captured here, and for a long time this note was unique, but within the last few years they have become regular summer visitors, and they have been found nesting at about 43° north latitude, on Lake Michigan's shore. There are dozens of other instances of cases where birds formerly unknown hereabouts, or but rarely met with, have, within the last twenty years or so, become comparatively common, or even abundant.

The second civilized cause of the unnatural means of change, namely, removal of forests, is remarkable in its effects, and yet, although more birds are forced to leave neighborhoods totally denuded than there are new species to occupy the locality, still a county about two-thirds cleared and well peopled is sure to embrace more species of birds than is one with its trees all standing. In a four years' residence at the north and in a new county, I was, although on the alert, and daily making notes, able to secure a list of only one hundred and twenty-odd species; while here, in a district inhabited over twice as long, and with over nineteen-twentieths of the area cleared, I have a list of over one hundred greater.

A locality where the trees were all felled would not contain a hawk, owl, woodpecker, grouse, warbler, fly-catcher, jay, crow, and many other species; but there are also many species, as house-wrens, barn and eave-swallows, chimney swifts, robins, blue-birds, sparrows, and finches of several kinds, kingfishers, and all the plovers, snipes, sandpipers, ducks, geese, and divers, which could remain with us, and many of which would not appear at all if the country was covered with forest.

The only species which I am satisfied are disappearing rapidly from the devastation of forests are the black woodpecker and wild turkey; of these, both once common, the turkey is being exterminated, while the log-cock has sought other quarters and is seldom seen here now. The raven, once abundant hereabouts, has gone forever, while its place is taken by its near relative, the crow, which was once not found in this locality.

Perhaps under this heading we may properly mention that group of birds which have modified their nesting habits to suit the requirements in order to associate with man, and, as we might say, secure his protection. A remarkable instance is that of the so-called cliff-swallow, a bird which has appropriated the space around buildings under the eaves, and which is well known to the boys as the eave-swallow. It is impossible to say how long this modification has existed, but certainly not longer than three centuries, for even now the species clings to its primitive choice of location in the west, still sticking its mud-pellet habitation to the cliffs. The white-bellied swallow, house-wren, white-bellied nut-hatch, and blue-bird, all have modified their nesting habits to an extent, and occasionally occupy boxes and other receptacles placed for their accommodation. The common pewee boldly enters our barns, out-houses, and even attempts to occupy a nook on the front porch, from which it is unceremoniously ousted. Some years ago I found two pewee's nests built in the original style; they were attached to the roots of overturned trees. This was undoubtedly the primitive method of the pewee, until the fortunate appearance of civilized man, when little pewee quickly came to know an advantage, and he adopted buildings and bridges instead of overturned tree-roots.

The barn-swallow must have adopted the custom of building in the peaks of buildings many generations ago, for no one knows of its ever nesting otherwise. It is even said that the martin was provided with gourd houses before the discovery of America in 1492, and that the natives afforded protection to this favored bird. It now accepts the boxes erected for it, or nests in the cornices of buildings in our cities and towns. The chimney-swift is the best example of a species changing from a life in the solitudes to the busy scenes of village and city. Once the swift must have nested in the cavities of trees, and I have heard of nests being found in huge, hollow sycamores, but at present the birds almost confine their nesting haunts to unused chimneys.

The third cause of change, viz., drainage of land and water, does not produce the great influence that the removal of forests does. Nevertheless, it exerts more of a change than one would credit. Many places where rails once nested in abundance, and ducks annually stopped on their migrations, are now comparatively dry fields and yield good crops. However, these drainings are almost compensated for by the overflow occasioned by the damming-up of streams and the outlets of lakes, as a head for mills, and, further, where lakes have been lowered by various means, it has not infrequently happened that the uncovered shore-line, so increased, has offered attractions to certain littoral species which were formerly rare, but which are now taken seasonally during migrations.

Enough could be written on this subject to fill a book, but space forbids further comment. It has been plainly shown that peopling a locality, with not too heavy a sprinkling over the agricultural portion, and not too heavy a removal of the trees, actually increases the number of the species of birds, and, with a few exceptions, principally the ducks, increases the number of birds. Though our little corporation does not contain as many birds as formerly, as they are crowded out, I am satisfied that there are in our county each year at least fifty species of birds unknown to the locality fifty years ago.

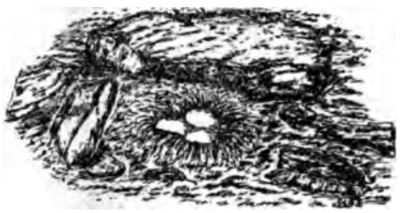
Kalamazoo, Michigan.

THE DUCK ISLANDS.[1]

BY LEVI W. MENGEL, ENTOMOLOGIST TO WEST GREENLAND EXPEDITION, 1891.

WE left Upernavick toward noon of July 1, with the "Kite's" head to the north-west. On the following morning we were awakened by the cry of "Land, Ho," and upon reaching the deck saw in the distance several small specks, which we were told were the famous Duck Islands, so-called because almost their only inhabitants are the American Eider Ducks which congregate there in the summer to breed.

The party immediately began to prepare for the day's work, and at four o'clock we brought up under the lee of the largest of the islands. The Duck Islands are situated about 73° north and 58° west, and are three in number. They are all small, the largest



AN EIDER DUCK NEST.

not being more than a mile and a half in diameter; all near together, and composed of the same kind of rock, which appeared to be granitic or at least of some igneous origin.

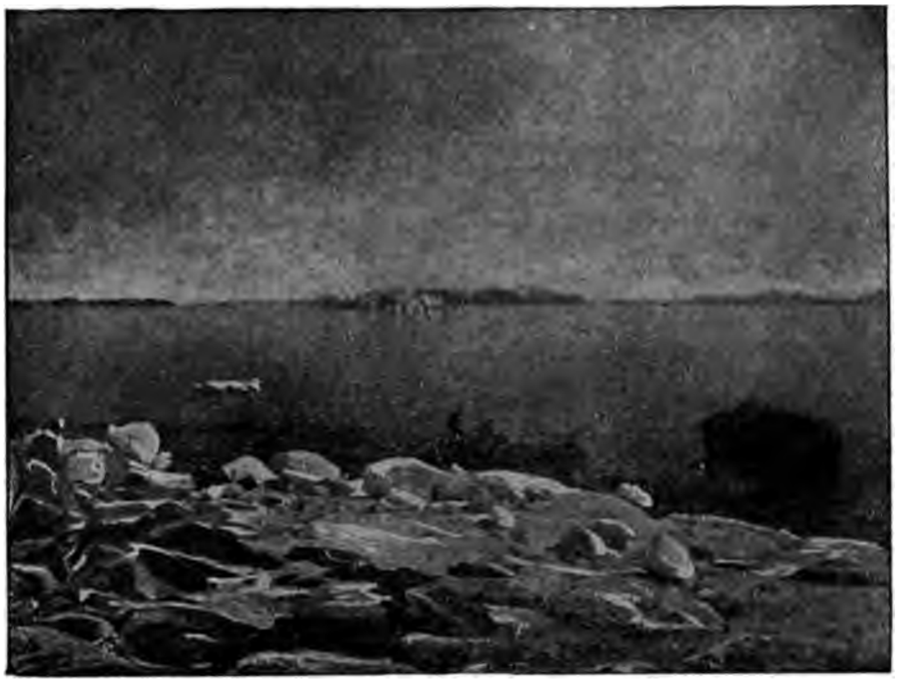
Our party were soon ready to go on shore. A gun was fired from the ship, and a black cloud of birds arose from the islands. They flew a short distance and then alighted, most on land, yet some in the water. We were soon on shore, and then began a day of sport and slaughter. A portion of the party was detailed to gather eggs and down for the use of Lieutenant Peary in the far north. The remainder of the party were to gun for as many birds as they could get; and we got them. Seldom did a shot fail to bring down a bird, and from every portion of the islands came rapid reports which told of slaughter and death. One could not walk even a short distance before coming to a nest, and not unfrequently did the female wait until almost trodden upon before flying. The male birds betook themselves away upon the first scent of danger, and upon the water nearby, just provokingly beyond gunshot, could be seen numbers of them, many wounded but sufficiently active to keep away. Of the birds shot the females largely predominated, probably ten to one.

The nests of these birds were all built on the ground (see illustration), some on the open, and some few under the shelter of

[1] The plates have been kindly loaned for this article by Dr. R. N. Keely Jr., of Philadelphia, and are from his excellent narrative "In Arctic Seas."

huge rocks and boulders. They varied somewhat in size, though averaging about a foot in diameter, outside measure. They were uniform in color, made of fine feathers and down plucked from the breast, the whole effect being dull gray. The eggs were from three to six in number, of a dull grayish-green or drab color, which varied slightly in the different nests. The average of fifty-one eggs from thirteen nests is 3.05×2.00. The female, if startled, deposits excrement, and partially covers the nest with down by a quick back motion of her feet. In many nests examined this was not the case, and in all probability the female was away feeding at the time of our arrival. Nearly all of our party reported the same in the nests of startled birds. Whether done to conceal the eggs or whether done through fright is entirely a matter of conjecture.

At the time of our visit to Duck Islands, incubation was begun in nearly all cases; in many far advanced; and though several barrels of eggs were collected, there were but very few which would be of any use to Peary. The birds, though to us they seemed very abundant, were thought by Captain Pike to be rather scanty in number. Probably some Arctic whaler had been there before us. This supposition may have been correct, as the sets



DUCK ISLANDS.

of eggs we collected contained but from three to six, while most authorities give from six to ten as the normal number.

Besides the eider ducks, there was but little else of interest on the islands. Two or three snowflakes, *Plectophanes nivalis* (Linn) Mayer, a northern phalecope, *Lobipes hyperboreas* (Linn), Cuv., and a single king-eider, *Somateria spectabilis* (Linn) Boie, made the entire list of birds. Several spiders and an ant, which was not caught, made up the rest of animal life observed; although there were several pools which looked as if they might be worthy of investigation.

The "Kite" had been steaming constantly from place to place. to avoid the bergs floating in the vicinity; and at 12 M., much against our wishes, we were recalled to pursue our journey northward.

Reading, Pa., Sept. 19.

PREPARATION OF TEACHERS OF SCIENCE AS CARRIED FORWARD IN THE MICHIGAN STATE NORMAL SCHOOL.

BY E. A. STRONG.

THE list of towns and villages in our country having a population below 20,000, or even below 10,000, is a large one. In these towns the number of pupils who attend a public high school is relatively much greater than in the larger cities, partly because these schools receive considerable accessions from the surrounding country, and partly because the smaller towns are not well supplied with private and technical schools to divide the attendance. So it comes about that a large part of the membership of the public secondary schools of our land is found in the villages and minor cities. In many of these towns education is a leading interest, the teachers are a favored and highly respected class, and the schools are managed with vigor and intelligence.

Now it is in the schools of these smaller cities and villages that the graduates of the numerous normal schools of our land find employment, either as superintendents, principals, or instructors. The district or rural schools rarely feel that they can retain the services of a trained teacher, so that the constant effort of normal faculties to induce their graduates to "go into the country and build up the rural schools" are only moderately successful. In the large cities the corps of teachers is usually recruited from the local high school or training school with little aid from without, and thus it becomes the distinctive work of the normal schools to give tone to education in communities too small to support a training school.

This is a great work, and it need hardly be said that it yet wants much of even reasonably complete accomplishment. Still, during the past few years there has been great improvement in the training of teachers, and the normal schools of the land are coming to deserve more and more the interest and sympathy of the friends of sound learning. A concrete example may best exhibit what the normal schools are doing or attempting, and the department of the physical sciences in the Michigan State Normal School will be used for this purpose.

Of the thousand students in this school rather more than one-half take the full or four-years' courses, and about one-third of this number specialize their work in the direction either of the biological or the physical sciences. Of those who elect the physical sciences about 63 per cent have during the past five years come to the school certificated as graduates of "approved high schools," 19 out of a class of 21 being the largest ratio and 18 out of 63 the smallest. Of those who went out from the school between the years 1885 and 1890, 86 are teaching or have taught physics in some high school, and fifty-four are teaching or have taught chemistry. These numbers seem small; but it must not be forgotten that many of these people take up teaching as a life-work, and that the number of normal schools with a presumably similar or better record is very considerable.

The teaching force in this department is supplied by three instructors, with some regular and efficient assistance from advanced pupils, many of whom are teachers of experience. The department occupies three floors in the south-east angle of the building. Upon the lower floor is a shop, 83 feet by 28 feet, with a modest equipment of lathes, benches, and tools; a physical laboratory, 34 feet by 54 feet, supplied with water, gas, stone and oak tables and benches, a water-motor, a small dynamo and accessories, and a considerable collection of American, English, and German apparatus for measurement; a store-room, twelve feet square, containing cases for apparatus, one side of the room being used as a balance-room; two dark rooms, each 6 feet by 15 feet, with optical benches and the usual equipment for photometry and lens work, one side of one of the rooms being fitted up for primary batteries. Upon the middle floor is a recitation-room and laboratory for elementary physics, 34 feet square, furnished with recitation seats and tables for students' work, cases for students' apparatus and demonstration tables; an apparatus-room, 12 feet by 30 feet, with cases for demonstration, apparatus and tables for teachers' use; and a recitation-room and laboratory for higher physics, 20 feet by 24 feet, with the necessary furnishings and equipment. The third floor is devoted to chemistry, and contains a lecture-room, 20 feet by 24 feet, a laboratory 34 feet square, with tables for 40 students, and a work and store-room 12 feet by 30 feet, all with the usual fittings, apparatus, and appliances.

The course of study of this department contains the following titles: 1, Physics I.; 2, Physics II.; 3, Physical Laboratory Practice; 4, Training in the Physical Sciences; 5, General Chemistry; 6, Advanced Chemistry; 7, Physical Technics, including Advanced Laboratory Practice; 8, General Astronomy; 9, Advanced Physics; 10, Instrumental Astronomy; 11, Sanitary Science; 12, Meteorology.

The first five subjects in this list are taken by nearly all intending teachers who graduate upon the four-years' courses, and are designed to give some knowledge of the content and the methods of the physical sciences and such skill in manipulation as are needed in general teaching. The three numbers following also form a natural group designed to meet the wants of special teachers of the physical sciences. The last three are post-graduate subjects. Physics I. is a course, complete in itself, consisting of a daily lesson for twenty weeks, with additional laboratory work, upon molecular and mass mechanics. Special prominence is given to the states and properties of matter and the transference of energy. Physics II., a course of the same extent upon sound, electricity, and light, is also made complete within itself as far as possible to meet the wants of those students who have had a brief course in physics elsewhere, but who wish to extend their knowledge of these subjects. For most pupils the two form a continuous course of one year, with supplementary practical work.

The only condition for entering upon this subject is the completion of algebra and plane geometry; but the high average age of the members of the class, — between nineteen and twenty,— coupled with the fact that a large number of those who enter upon this subject have already completed elementary physics in one of our excellent high schools and desire to review and extend their studies in this direction with reference to teaching, permits and invites a strong and extended course.

The experimental work is of two sorts, teacher's class experiments or demonstrations and students' individual work carried forward at their tables. Our experience would indicate that the former cannot be entirely omitted without loss. A piece of apparatus does not teach its own best use. The student who knows how to investigate thoroughly and to question himself wisely has already passed the elementary stage of scientific work. As to the character of this demonstration apparatus, a portion consists of the ordinary apparatus sold by dealers, but a still larger portion is derived from the home, the farm, and the workshop — commercial, working pieces. Important demonstrations are repeated by pupils before the class, so that they may get a feeling for artistic demonstration and neat manipulation before a class. This is regarded as very important, though it is far easier to gain this ability than the power to question wisely. The catechism is the infinite matter.

In addition to these daily class demonstrations, our c contemplates students' individual work, mainly in measurei two afternoons a week after the "collective" system. Tl each member of the class has a piece of apparatus exactl that of the others, and does the same work in the same time each student is supplied with a balance in case, turning easily one milligram, with fine weights; a set of burettes and meas glasses, English and metric units divided with accuracy, ar general, examples of the simpler apparatus in dynamics, electricity, and optics.

As to method, a very important part of the work is pres inductively. That is, physical changes are observed and desc by members of the class; the conditions upon which changes depend are then varied in many cases and in many and in each case the pupils are asked to observe and des Wise questioning leads the class to distinguish that which i stant from that which is variable in these changes until th which governs them comes spontaneously into view and is apprehended and formulated. With somewhat similar ma and under somewhat similar circumstances the pupil repeat work at his own table. Further illustrations, exercises, and lems follow. If a book is used — as is the case in a portion work — the subject is assigned as a lesson to be recited in form — the least valuable part of the work, but still not wi value. So, by the exhibition of material and wise questio the pupil passes from the observation and statement of fact apprehension and statement of law. It hardly needs to be that this so-called inductive method is not identical witl method of discovery, since the student would not of his ow stance know what experiments to try or what questions to but from his point of view he is a real discoverer of fact and and the process has to him the interest and especially the su iveness of discovery.

The method of verification and illustration is also freely by which that which is dubiously or imperfectly known is br into fuller knowledge. This method blends easily with th ceding. Resort is had to the method of authority for tho merous cases in which experiment and verification are impo under the circumstances. This is especially necessary in th of a teacher, who needs to have a complete view of his su and who must appeal to book or lecture for the ground of of his knowledge. This knowledge of what other people found to be true is so vivified by the more vital knowledg the student has gained for himself by similar methods, tha neither unreal nor unfruitful. Much attention is given her elsewhere to the selection, care, and use of apparatus, t graphical method of recording facts, and to the bibliograp physical science.

3. Laboratory Practice. This consists of "separate," or vidual, work for ten weeks in physical measurements, foll and completing the preceding courses. As the members c classes in laboratory practice have passed over the whole c mentary physics, they are prepared to take any experiment w the range of this subject. Each student works with a diff piece of apparatus and continues its use until he has maste and secured the highest attainable results. Thus it is not sary to duplicate pieces, and this saving in the cost of exte duplication is applied to the purchase of apparatus of a h grade and of greater variety than would otherwise be pos and thus the course is made more extended and exacting tl could be under the "collective" system. Moreover, many of apparatus in mechanics and heat have optical or electric cessories which can be understood and put into action on students who have completed a course in physics. But th reason for preferring the "separate" system in any serious in laboratory practice is the facility which it affords for vidual and independent work according to observed ca and advancement. No text-book is used, but exercises a from a printed list containing references to Pickering, St and Gee, Glazebrook and Shaw, Worthington, Whiting, other authors, with whose works the laboratory is supplied.

4. Training in the Physical Sciences. This is a course in **ods, and consists of two parts — theory, presented by quizze**

tures, and reading; and practice, in which the members of the class taking the scientific course teach the elements of this subject for a term of weeks in the school of practice. The philosophy of methods rather than a definite course of practice mainly engages attention, and yet that most difficult special problem in modern pedagogy, how to teach the elements of the sciences in a real way to pupils below the high school, is attacked with vigor, and a possible course is marked out and illustrated in detail. Much time is also given to practical work in the smaller high schools. The course of reading in this class is quite extended, and its members become somewhat familiar with the best European and American methods of teaching secondary physics.

5, 6. Chemistry and advanced chemistry. In these subjects the members of the scientific course complete Remsen's "General Chemistry," Jones's "Junior Course in Qualitative Analysis," and have ten weeks' quantitative work. The work is arranged with special reference to teachers. The students have much practice in demonstration before the class, in the preparation of apparatus and reagents, in gas analysis, in blowpiping, and the attempt is made to interest each one in some sort of practical work which he will be able to continue, and in some chemical periodical which he will desire to read as a teacher.

7. Physical Technics. The subject of this course is the laboratory method, which is here viewed from its practical side as it is from its theoretical side in the course in training. Robins's "Technical School and College Building" is made the authority in most matters of construction. The members of the class make detailed plans and specifications for fitting up an ordinary schoolroom as a laboratory for physics or chemistry or both, and with various degrees of elaboration; prepare lists of apparatus of varying cost from $50 to $1000; and report in full, with drawings and price-lists, upon some high-school or college laboratory which is visited for this purpose. All do much practical work in making and especially in repairing apparatus; construct some important piece; have much practice in testing balances, galvanometers, etc.; report monographically upon some assigned topic, as, for example, the best form and material for fine weights, the spiral-spring balance as an instrument of precision, comparison of photometers, conditions determining the size of drops, etc.; and have much careful and continued practice with at least two instruments of precision, which were in general used with less completeness in the regular laboratory course, as the spectroscope, the saccharimeter, the sextant, the astronomical transit, etc.

8. Astronomy. The essence of this work consists in the actual observation of the heavens with the unarmed eye, an opera glass, and a small telescope during one school-year. Great familiarity with the constellations is secured, and a full set of drawings showing the observed motion among the stars, and the telescopic appearance, at frequent intervals, of the moon and the planets visible under favorable circumstances during the year. A good high-school text-book is incidentally gone through with.

9. Advanced Physics. The objective point here is a mathematical view of physical science and the ability to read the stronger scientific books and periodicals with ease and profit. Those who enter the class have had work in trigonometry, higher algebra, and the calculus, and are able to master an advanced text-book. Much practical work is also done with the purpose of leading the members of the class toward some course of study or investigation to relieve and vivify their subsequent teaching. The post-graduate work will not be described as it has not yet become important.

It may be asked whether this preparation is sufficient to make a well-furnished teacher of science. For myself I would frankly answer, no. The highest attainable preparation is not sufficient, it is only hopeful — in the way to become sufficient. Our candidate for success as a teacher has been all along taught that the first condition of success is intimate and exact knowledge of his subject. He already has some knowledge and has been put in the way of getting more, and surely this is a hopeful condition. If it were further queried whether this man would not have done more wisely to attend a technical school or college for four years as a preparation for teaching science rather than give a large part of his time to English, history, mathematics, and German, to the study of children, to practice-teaching, and to the history and philosophy of education, I would reply that it depends upon who the man is. A native talent for teaching or exceptional knowledge and love of young people may render the intending teacher independent of formal professional instruction; but it is my own observation continued for many years as principal of a large high school and superintendent of a system of schools, that the normal graduate will be the more painstaking and studious man, and that he will, in the long run and with important exceptions, do finer, sounder, and more rapid teaching than the technical student. At any rate he has fairly emerged upon the field of advanced secondary instruction and deserves recognition and interested and sympathetic criticism.

Ypsilanti, Mich., Sept. 17.

NOTES AND NEWS.

A PARISIAN Inventors' Academy is distributing letters to inventors in this country, informing them that "after examination of your last invention the Academy has conferred upon you the title of Honorary Member (*Membre d'honneur*) with award of the first-class Diploma and the Great Gold Medal (gilded)," on receipt of ten dollars to defray the cost of the gilded medal, etc. We advise our readers, if so addressed, to consider the value and probable standing of that institution very carefully before sending on their ten dollars. A note to our consul in Paris might assist them in securing such testimony as they may require on this point.

— Recently a communication from the Lick Observatory recorded a phenomenon which was thought to be as unique as it was beautiful. Fog filled a valley, and upon its level surface the mountain peaks were mirrored as if from a placid lake. Strangely, in the *Yorkshire Herald* of Sept. 7, "An Early Riser" records a precisely similar phenomenon at 6 A.M. on Sept. 5; It was seen from Leyburn, which overlooks Wensleydale. This lovely Yorkshire valley was half filled with fog, which looked like a mighty flood or lake. Upon it the opposite slopes, lit up by the bright sunshine, were reflected with "extraordinary distinctness."

— G. P. Putnam's Sons have in active preparation an edition of the "Works of Thomas Paine," which will be edited by Moncure D. Conway, author of "The Life of Thomas Paine" which they have just issued. The set will be in two or three volumes, the first division being devoted to the political and sociological writings, and the second to the religious and literary papers, of which the most important is "The Age of Reason." The volumes will be uniform with Mr. Conway's biography, and will include essays of importance not in any previous collection

— In "A Chapter in Meteorological Discovery," in the October *Popular Science Monthly*, Mr. John Coleman Adams presents Benjamin Franklin as the father of American meteorology, and shows the part which Redfield, Espy, Dr. Hare, Professor Loomis, Blodgett, Mitchell, Coffin, and Dr. Joseph Henry have severally had in building up the science. A philosophical discussion, of much value and interest to thoughtful people, of the best methods of really learning foreign languages is given by Dr. Howell T. Pershing, in an article on "Language and Brain Disease." A curious and liberally illustrated article on the "Evolution of Dancing," by Lee J. Vance, shows how the custom has been largely derived from the religious, mystic, or festive exercises of the human races in the earlier stages of their civilization, and illustrates the various forms which dances assume among different peoples. Pertinently to the present vogue of the "Keeley Cure," Dr. T. D. Crothers discusses the merits of the various specifics for the cure of inebriety that have claimed attention at different times. An important article will appear on the disadvantages which the conditions of modern city-life throw in the way of the best physiological development of children, by Dr. Henry Ling Taylor. The subject is fully reviewed in a philosophical manner, and the attempt is made to measure the influence for good or ill which each of the factors in which city conditions differ from those of the country exerts upon the child's bodily and mental faculties.

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THE FICTION OF THE AMERICAN HORSE AND THE TRUTH ON THIS DISPUTED POINT.

BY DR. E. L. TROUESSART.

THE article of Mr. Robert C. Auld, published in *Science*, Sept. 2, 1892, brings before us the question of the introduction of the horse (*Equus domesticus*) into America, It is generally accepted that Europeans brought it to the New Continent, and that it was in La Plata that Mendoza, in 1530, introduced horses. Before that time, the natives were familiar with the llama only.

The only document which contradicts this historical fact, is a map published by Sebastian Cabot, on his return to Europe, that is after 1530, and which, moreover, had several editions. On this map, Cabot figured the horse as a production of the Rio de la Plata. It is difficult to attach any faith to this assertion of Cabot, since it depends very probably, upon the same doubtful grounds as the existence of the gold and silver mines in this country to which he gave, fortunately or unfortunately, the name of "La Plata." We know that all the objects of gold and silver which Cabot obtained from the natives were brought from Peru and from Chili, and that no metallic productions of any kind are to be found in this part of the Argentine Republic. But to Cabot—desirous above all things of dazzling the King of Spain, and later the King of England, in order to obtain the command of new expeditions for discovery—it was essential to make it appear that these lands abounded in riches and supported large herds of horses. It is quite likely, too, that Cabot knew that the horse, recently imported into the country, could survive there and multiply in a state of freedom.

Be that as it may, all navigators who visited Rio de la Plata, before and after Cabot, contradict his assertions and agree in affirming that the natives did not know the horse. Pigafetta, notably, the historian of the voyage of Magellan, who visited Rio de la Plata in 1519, and who enumerates with care all the productions of the animal and vegetable kingdoms of that country, says authoritatively that the natives knew no other beast of burden than the llama (*guanaco*).

It is time, therefore, to make an end of this fiction of the native American horse. It is certain that this animal was imported by Europeans into America and that the *Equidæ*, which had formerly existed on that continent, were entirely unknown to the red men. We recall the terror of the Caribbeans, the Mexicans, and the Peruvians, at the sight of the Spanish cavaliers: they believed themselves in the presence of a herd of centaurs. Geological and palæontological evidence in regard to the Argentine Republic abounds, also, to prove, in the most convincing manner, that there elapsed a period, between the extinction of the indigenous American horse and the appearance of the domestic horse imported from Europe, which was quite long enough to be appreciable geologically. This is the point which is now to be demonstrated.

We know that the horse of three toes (*Hipparion* or *Hippotherium*) existed in the north of the two continents at the end of the tertiary period (Pliocene and Quaternary). The genus *Protohippus*, considered the direct progenitor of *Equus*, differs very little from *Hipparion*, and may be regarded as a simple sub-genus of the latter. This genus, *Protohippus*, which numbers several species, lived in North America during the Pliocene epoch. The true genus, *Equus*, appeared soon after in the same country (from the Pliocene epoch), and several species (*Equus crenidens*, *E. barcœni*, etc.) are contemporaneous with *Hipparion* and *Protohippus*.

A genus akin to *Equus*, the genus *Hippidium*, is found also in the Pliocene age of North America (*Hippidium spectans*, Cope). This genus is the only one (with the true *Equus*) which is found in the Quaternary epoch in South America. Indeed, *Hipparion* and *Protohippus* are not known there, and *Hipphaplus* (*Ameghino*) is too little known to take up our attention here. There seems to be no doubt, therefore, that the South American horses of the Quaternary age spread gradually across the continent, from Mexico to Colombia, Brazil, and the Argentine Republic, for before this period *Macrauchenidæ*, the *Proterotheridæ* and the *Tapiridæ* were the only Perissodactyls living in the last-named country.

The South American horses (genus *Hippidium*) bear characteristics which forbid confusing them with the Hipparions and the horses of the North. Those of South America had thick, squat bodies, large heads, slender legs tapering to small hoofs; their molar teeth were of a shape more square than those of the true horse. These peculiarities are found again, in a measure at least, in horses of the same country which have been referred to the true genus *Equus*. In the same way, the *Equus lundii* of Boas, which lived in Colombia in the Quaternary period, has been compared to the zebra because of the thickness of its form. The other species which were found in the Argentine Republic are *Equus curvidens*, *E. argentinus*, and *E. rectidens*; this last is the one which lived longest in this country where it must have been hunted and eaten by prehistoric man. In the "étage platien" (upper Quaternary) are found bones of this horse (*E. rectidens*) associated with chipped-stone implements, with pottery, fire refuse, etc., which are the evidences of the presence of man. The long bones of this horse are often split for the extraction of the marrow and the skull broken for the brains. The shape of the teeth enables one to distinguish at once between the *Equus rectidens* and *Equus caballus* of Europe.

If we study now the geological strata of the Argentine Republic we may form the following table whose elements we borrow from Mons. Fl. Ameghino:

ETAGES.		EQUIDÆ QUI S'Y TROUVENT.
Aérien (actuel)		*Equus caballus domesticus.*
Aimara (récent)		(Pas trace d' *Equidæ*).
Platien (post-pampéen lacustre)		*Equus rectidens.*
Guerandien (post-pampéen marin)		(Pas de Mammifères terrestres).
Lujanien	Pampéen	*Equus rectidens.*
Bonairien		*Equus argentinus.*
Belgranien		*Equus curvidens.*
Ensenadien		*Hippidium* (5 sp.).
		Hipphaplus (2 sp.).

This table, in which the "ensenadien" formation is the most ancient, and the layer "aérien," or actual, the most modern, shows, in the most evident manner, that the true horse of South America (*Equus rectidens*) was extinct a long time when *Equus caballus*, coming from Europe, made his first appearance in the Argentine Republic.

Indeed, the "Aimara" formation, where the bones of the llama (*Auchenia guanaco*) are abundant, presents no trace whatever of the genus *Equus*.

This geological proof seems to me to be absolutely incontrovertible, and reduces to *nil* hypotheses built on the apocryphal documents left by an adventurer like Sebastian Cabot, the inaccuracies of which, not to say the fancies, are shown by the examples we have cited.

The true horse (*Equus*) has been scattered more widely, and has given rise to more species in North America than South America. It is interesting to recall here that the remains of *Equus caballus* have been discovered in the Quaternary beds (Pleistocene) of Canada and of Alaska. It is therefore certain that this species has existed in the *wild state* in the American Arctic region. But it is not less certain, according to all historical documents, that this animal had not existed for ages when it was introduced by Europeans in the early part of the 16th century. What is the cause which brought about the extinction of horses in North America as in South America before the commencement of the present period? This is not the place to discuss that question. But I cannot refrain from remarking that the extinction appears to have coincided with that of the *Proboscidians* (Elephant, Mastodon) and can consequently be attributed to the same causes which are to be sought in the environment of these *Herbivoræ* (nourishment, nature of the soil, etc.)

For the present it will suffice to establish that the *Mastodon superbus* was contemporaneous with the *Equus rectidens* in the in the Quaternary (Pleistocene) of the Argentine Republic. Also *Elephas primigenius* is found with *Equus caballus* in the same age in North America. All these types of animals became extinct in the New World, although horses and elephants have continued to live in Asia and in Africa up to the present time.

ADAPTATION OF SEEDS TO FACILITATE GERMINATION.

BY W. W. ROWLEE, CORNELL UNIVERSITY, ITHACA, N.Y.

THE observations recorded in these notes are based upon the general law of evolution, that organisms are constantly adapting themselves to secure advantages in their struggle for existence; and, because of this, it is to be expected that all modifications of organisms have some explanation in the economy of their existence.

From the initiation of the young plant into life at the time of fertilization of the ovule, to the end of the life of the mature plant, there is no more critical period in its existence than when it is dormant in the mature seed. It may be said in objection to this statement, that such seeds as corn, wheat, and garden seeds in general, when planted, almost all germinate, and this is true; but these seeds are removed by artificial intervention from the competition with which those planted naturally are compelled to struggle. These seeds, then, may be left out of consideration.

Careful observation of the seeds of native plants shows that a very large percentage of them never germinate. Some, no doubt, were never fertilized. I have counted a thousand seeds of different species of plants belonging to the Order Compositæ, and then planted them carefully, giving them as good, if not better, conditions for germination than they would have had if they had been planted naturally, with the result that in most of the species a comparatively small number germinated. Anyone who will take the trouble to search for seedlings of our native perennial plants, and compare the number they find with the number of seeds produced by the plant, will be convinced without further argument that the larger proportion of seeds produced by wild plants never germinate at all. In view of the critical period in the life of the plant when it is dormant in the seed as an embryo, and recognizing the evolutionary law of the survival of the fittest, is it not reasonable to expect that modifications of the seed will be developed which will facilitate germination? What are some of the modifications which increase the chances for germination of the seed?

In general, it may be said that seeds vary as to the structure of the parts within the coats, as well as to the external appendages of the outer coat. The internal characters are concerned with the embryo and the albumen. The embryo is the essential part of the seed. It consists of an initial stem, the hypocotyl, at each end of which is a growing point, one, the plumule, destined to produce the stem, the other, always at the other end of the hypocotyl (usually termed the lower end), from which the primary root starts. At the upper end of the hypocotyl, but below the plumule, are the cotyledons, sometimes large, sometimes small. Surrounding the embryo more or less, and inside the coats, is the material upon which the embryo is nourished until it can carry on an independent existence. This is termed the albumen of the seed. Around all are the seed-coats.

Moisture is as necessary to the germination of a seed as any other external condition. The necessity for moisture would make it highly probable that seeds should have special modifications to secure it to the seed. It is my purpose to point out some of the adaptations which seem to me to be designed to increase the facility and certainty of germination by securing and likewise keeping constant the supply of moisture for the seed. Some of the characters which will be mentioned have been considered as aiding the seed in its distribution. These are flattened or feathered appendages commonly known as pappus, coma, etc. It is not my purpose to belittle the office of distribution as performed by these organs, but it does seem to me true that, while these organs do assist the seed in dissemination, they, at the same time, aid in bringing it into the most advantageous position for germination. This advantage is often gained by the correlation of the internal parts of the seed, especially the growing points, to the external appendages of the seed or fruit. It is frequently the case that there is but one seed in the ovary, and the coats of the ovary closely invest the seed. Such a fruit is an akene. If the ovary- and seed-coats are completely fused together, the fruit is a caryopsis. For the purposes of our study these fruits may be included in the same category with seeds proper.

The correlation of parts in the seeds of many species is very striking. In the akenes of most of the species of the Order Compositæ it is especially noteworthy, and in several other orders seeds occur showing the same correlation. They might well be likened to an arrow. The feathered end is light, the head is heavy. In falling, the heavy part, i.e., the part which contains the embryo, is brought by the force of gravity invariably into close contact with the soil.

The same correlation of parts may been seen in the winged fruit of any species of maple. There is a very fruitful silver-leaved maple (A. dasycarpum) near my study. Under it passes a hard gravel path. The fruits that fell in the smooth path, of course, fell over on their side. Those that fell in the grass of the lawn, almost invariably assumed a position with the wing up and the body of the fruit down in the grass and leaves in contact with the moist soil. Further, I found that not a single seed in the path had germinated, when many of those in the grass had done so. It was interesting to see those large seeds all wing-up in the grass.

Most of the fruits of plants belonging to the Order Compositæ are especially adapted to facilitate germination. As is well known, the fruit is crowned with a pappus, which in a majority of cases not only acts like a parachute and bears the seed away, but at the same time lands it always a certain end up. The hypocotyl is very short in proportion to the length of the cotyledons, and is always in the lower end of the seed. Thus the growing points are brought into close and constant contact with the moisture of the soil. I have observed these akenes in fields and woods lodged usually, I might safely say, almost always, in such a position as to bring the akene with its lower tip in contact with the soil. If it fell in an open, smooth place, it would tip over, but, although reclining, would still have the lower tip upon the ground. If it fell among grass, leaves, or *débris* of any sort, as seeds are very apt to do, these would keep it in an upright position, and, on account of the barbed or upwardly roughened nature of many forms of pappus, it would work its way down until it came in contact with a suitable place for germination.

To determine whether this could be proven experimentally or not, I carefully selected a certain number of seeds of twenty different species, and planted one half of them one end up, the other half with the other end up. I had grave doubts about the success of the experiment, and should not have considered the proposition improbable had no differences in the rate of germination appeared.

All the seeds were placed under the soil and put as nearly as possible under the same conditions. Whenever the weather was dry, they were watered twice every day. Five species germinated twice as many seed when planted pappus end up as the same species did when planted pappus end down.

This at least suggests a reason for the inversion of the ovule in these and many other seeds. By assuming the anatropous form, the seeds in this order are able to bring their hypocotyl near the opening at the base of the akene, and at the same time secure advantages to themselves in the process of germination. I cannot help but believe that these adaptations are a factor in making the Order Compositæ the largest of the orders of flowering plants, in the number of its species as well as in the great abundance of individuals in some of its species.

WOMAN'S WORK FOR WAGES.

BY C. R. HENDERSON, RECORDER AND ASSISTANT PROFESSOR OF SOCIAL SCIENCE IN THE UNIVERSITY OF CHICAGO.

SOCIAL science has few more important problems than the conditions and effects of the earning of wages by women. Some sanguine advocates of women's rights apparently do not see that there are grave perils attending the enlargement of industrial activities on the part of the natural mistress of the home. They hail with rapture unmixed with foreboding the mere fact that the former "slaves of men" are becoming independent of the lords of creation. That access to new employments has its bright side there can be no reasonable doubt. There is a physical gain if the work is confined within certain limits and is adapted to the frame and forces of the sister toiler. Regular labor in sunny and well-ventilated rooms, or even in the open fields, is far better for health than idleness and husband-trapping. Intellectually, the sphere of mental life is vastly enlarged by the modern diversity of employment. There are domestic and social advantages in being able to wait and select a husband rather than take up the first thing in the shape of a man who offers a secure living. The economical advantage is so apparent that it needs nothing more than mention. At first sight all that a girl earns is clear gain, and is an absolute addition to the income of the family. In many occupations the dexterity, deftness, and honesty of female helpers have proved their superior value. As nurses, physicians of women and children, matrons of institutions requiring the presence of ladies, their gentleness and insight have been an untold blessing. These advantages are so real and great that any modifications of the present tendency to widen the industrial sphere of woman must take them into the account.

But there is also a very dark side to this subject. Passing the dangers of imposing labor prematurely on young girls, consider the indirect effects of feminine competition in some lines. That which we first see is a positive addition to family revenue. But later we discover that girls are taking the places of men at lower rates. This often means that the natural head and bread-winner is out of work or is receiving the woman's rate. The girl has herself to support, and that only in part. The man must support at least four persons. What must be the effect on domestic life? That which is actually observed: the husband and father at home while the daughter or wife is in the factory earning the living. Marriages are dimished, and among those most suitable for parents there are fewer births. A recent French economist of high repute gravely declares that the State ought to support and educate foundlings and orphans because the better members of society either cannot or will not keep up the population. What must be the results of propagating a human stock with such pedigrees? Ask the Kentucky horse-breeders. Think of the disorder of households where the normal conditions are reversed, the wife being in field or shop. Dr. Bushnell wrote about a "a reform against nature." It is against civilized human nature to throw the burdens of procuring sustenance upon those who have all they can endure in bearing, nursing, and starting the education of children. That cannot be a good tendency, economically or morally, which tends to extinguish a higher race. Herbert Spencer, in his pages on the *status* of women, gives abundant illustrations of the law that the imposition of bread-winning on women belongs with savage conditions.

What can be done to secure the advantages of women's work for wages and avoid the perils? There are natural forces which counteract the momentum of these evils. Fortunately it is the disposition of most women to have a home of their own. This inclination, deep as human life and old as history, removes much female competition. But unconscious forces need to be supplemented by foresight, prudence, and philosophy. Biology, as De Greef teaches, is not sociology. There is a physical law of "must" and a moral law of "may" and "ought." Women should be taught that she who works for less than normal wages in order to get "pin money" is the foe of her kind, and is undermining the foundations of economic and domestic welfare. This conviction, once generally diffused, will create trade-unions. These unions, because they are human, have done many foolish and wicked deeds. But they never did a more foolish or wicked deed than they have done who taught that unlimited work of women, at any price they could get, was an unmixed good. If women unite and demand the normal rate of wages then it will be found out whether it is really profitable to hire them. If their peculiar gifts give them superiority they will retain their places at the proper rate. If men are really more fit for the places, they will be preferred. Thus this social disease might be healed. To let it alone is to let a cancer alone, or permit incipient consumption or germs of cholera to have free-course. To take hold of the evil with will and unity is to cure it. Thus alone will young men be able to marry at a suitable age, and young women will generally find their most congenial and happy places as mothers and educators and home-makers. There is sufficient earning force in men without forcing children to eat scraps of bread and cake out of scavenger barrels and without compelling women to exhaust their energies in field and factory.

HEREDITY.

BY JULIA BROWN STRODE.

ALL men are created free and equal, says that famous document the Declaration of Independence, and, in a remote and abstract sense, it may be true; but, all in all, we are bound by a thousand chains, and equality is unknown. Fetters have been imposed upon us by our forefathers; limitations have been set us by our ancestors, which it will take years of study and self-culture to overcome. And as to equality, this man may average well in one particular with his fellow-men, but is totally deficient in another respect, and no two men are alike. Many of the lower tribes in Africa, says Stanley, resemble the ape more nearly than human beings. Either these lower classes have sprung from a brute ancestry, or their lives and environments have continued such that they have taken on the dispositions and appearance of the higher animals with which they have been surrounded, and have transmitted them to their progeny. Whether we accept the theory of evolution or not, the fact remains the same, i.e., that many savage tribes are more allied to animals than to civilized man. But, whatever our parentage is, or may have been, true worth is recognized and acknowledged wherever it may be found.

The problem of how to intensify the higher attributes of human nature and obliterate the unworthy is the problem of the age. The old theory that children were sent into the world, figuratively speaking, mere pieces of blank paper was long ago exploded. The paper is all written, traced, and re traced. The child has as decided a character, though not one so easily discernable, when it enters the world as when it leaves it. As genius, disease, peculiarities of appearance often transmit themselves from parent to children, so do villainy, crime, and moral depravity.

Here is a child with the idiosyncracies, the peculiar mannerisms, of his great-grandfather dead before he was born. I know of a boy whose attitudes and voice are like no other member of his family, but that of an uncle whom he never saw. Often an individual returning to his home town, from which he has for years been absent, readily determines to what families the new-born generation bel-

Drunkenness is an inherited disease. A celebrated physician makes an estimate that one-fourth of the cases of insanity are inherited. A race of scholars beget a race of learned men, men with brains capable of receiving much knowledge. Says Oliver Wendell Holmes in one of his greatest novels: "There are races of scholars among us, in which aptitude for learning is congenital and hereditary. Their names are always on some catalogue or other. They break out every generation or two in some learned labor, which calls them up after they seem to have died out. At last some newer name takes their place it may be; but you inquire a little and find it is the blood of the Edwardses, or the Chanceys, or the Ellerys, or some of the old historic scholars disguised under the altered name of some female descendant."

Of course, there are individuals and families continually working their way up into these intellectual classes, and their posterity will rank with them. But many of us have the way already paved for us in inherited aptitude and brain-power.

Often acquired traits are transmitted until they become a distinguishing characteristic of the race or family, a part of them as it were. Sometimes certain unions, "felicitous crosses," produce an improved strain of blood and a prodegy is born. A child adopted and far removed from its family usually shows forth the disposition of its own people. Occasionally such a one will escape. A generation or two may be skipped, but, sooner or later, the old hereditary traits reappear, breaking out in the blood of the race, no matter what the outer influences may be. Rev. Oscar C. McCulloch, in an address before the National Conference of Charities, stated his having traced a certain family back for the greater part of a century, until the individuals found belonging to it numbered over five thousand, all but one of whom were either vagabonds or criminals. But one of the entire number lived to be an honorable man. Says this reverend gentleman, as quoted by Edward S. Morse in a late number of the *Popular Science Monthly*: "Efforts have been made again and again to lift them, but they sink back. They are a decaying stock; they cannot longer live self-dependent. The children reappear with the old basket. The girl begins the life of prostitution, and is soon seen with her illegitimate child."

The entire populace of portions of our great cities is composed of an element such as this. Decency cannot exist within the borders of these slums. Truth cannot survive the diabolic cunning of the place. Missionaries and sanitary officers sent to aid this people are often murdered. "This class," says O. B. Fowler, "are an enormous expense to the State, a constant menace to society, a reality whose shadow is at once colossal and portentous." Millions of them every year start out over country as tramps, and return again to these quarters as winter sets in, to live by theft, crime, and beggary. Their increase is alarming. A race of vagabonds beget a race of vagabonds. What shall we do to prevent this increase? How shall we work a reformation? How shall we treat our criminals born, as it were, out of parallel with natural law? Shall such be allowed to beget a race in which their own characteristics are intensified? Shall such be treated as morally responsible for their misdoings? This is the great problem to be solved by our own and future generations.

"It is singular," says Holmes, "that we recognize all bodily defects that unfit a man for military service, and all intellectual ones that limit his range of thought; but always talk at him as if his moral powers were perfect. . . . I suppose," he continues, "that we must punish evil-doers as we extirpate vermin; but I don't know that we have any more right to judge them than we have to judge rats and mice, which are as good as cats and weasels, thought we think it necessary to treat them as criminals."

Truly, "the sins of the parent are visited on the children, even to the third and fourth generation." Truly, our influence is unending; our lives a blessing or a curse to all future time, just as the power and influence of the great past is interwoven within our own organizations.

Ah, yes! but hidden within this visible being is the *real man*, the overcomer, the spirit pure as when it left the Creator to be incarnated in mortal flesh. That let us recognize. Let us know ourselves, our faults and virtues, the chains that bind us, the aids that have been given us; but let us so recognize our own spirit lives, our real selves; let us so far become individualists that we are masters and not slaves to inherited tendencies. And let us attempt to solve this great problem, here cited, for the good of our fellow-men and the strengthening and bettering of future generations.

A CONSIDERATION OF THE CLAIMS OF CHEMISTRY AS THE BASIS OF MODERN AGRICULTURE.

BY FRANK T. SHUTT, M.A., CHIEF CHEMIST, DOMINION EXPERIMENTAL FARMS, OTTAWA, CANADA.

AGRICULTURE may be considered at once the oldest of all arts and the youngest of the sciences. It has always had for its object the economic production of plants and animals and the materials elaborated by them during their life. This fact gives us a definition for the term agriculture that was as correct centuries ago as it is now.

Until comparatively late years agriculture existed, as far as the farmer was concerned, as an art only. The application of scientific or classified knowledge to the feeding of plants and animals began with the researches of Liebig and Davy in the early part of the present century. Since then an ever-increasing band of scientists — now spread over the civilized world — has been studying this vast subject with gratifying results. Agriculture, properly so called, has now passed beyond the ranks of empiricism and entered the realms of science.

Strictly speaking, agriculture should not be called a science. The problems which it presents call for their solution upon chemistry, botany, zoölogy, geology, and physics. Mechanics are also more or less closely connected with agriculture as an art, and have been of immeasurable value in reducing the cost as well as increasing the yield of field-crops.

It is to chemistry and animal and vegetable physiology, however, that we look for the answers of innumerable questions that are continually arising in the development of those living things which the farmer has to deal with. Indeed, a little reflection will convince us that it is difficult to state an agricultural problem that does not make demands upon chemistry and physiology for its solution.

Chemistry has to do with the composition of all matter, inert and living, and the changes which such is constantly undergoing. The conversion of soil substances and the constituents of the air into vegetable tissues, and the formation from these of animal tissues and products, though not as yet fully understood, are, nevertheless, truly chemical changes. Looked at chemically, we see nature as the work-shop, plants and animals as the chief agencies, man as the director. The material worked with consists of a limited number of elementary substances and their compounds; plants and animals are continually performing with this material the operations of analysis and synthesis.

Physiology treats of the functions of living things and their various organs; it seeks to explain with the aid of chemistry all the phenomena of life. Living matter is made up of cells capable of nutrition and reproduction. As the result of cell development, animal and plant tissues are formed. The changes which take place in these cells, primarily leading to their nutrition, and secondarily to their reproduction, are true chemical transformations. It becomes clear, therefore, that physiology is largely chemistry, and that the latter science in many instances furnishes the foundation and explanation of vital or physiological processes.

Thus we establish the claim that chemistry forms the basis of scientific agriculture.

Leaving with this brief outline of the fundamental importance of chemistry in the abstract to agriculture, let us proceed to examine somewhat more in detail the aid that this science gives to the farmer. To pursue economically and intelligently, modern agriculture in any of its branches requires an application of the principles of chemistry, since every farm operation, whether performed by nature or man, implies, as may be inferred from what has already been said, changes of material which can only be explained by chemistry and its twin-sister science, physiology.

Chemistry affords definite knowledge as to the amounts of the several constituents taken from the soil by field-crops, thus indi-

cating what must be restored if fertility is to be maintained and lucrative yields obtained in the future. Such knowledge is well-nigh indispensable at the present day to the grower of grain, roots, and fruit if he is to compete successfully with his intelligent neighbors. Chemistry can tell us, in a large measure, of the relative fertility of a soil and point out what elements of plant-food may be lacking. It is the science that makes the barren and waste lands fruitful and is the chief agent in making "two blades of grass grow where there was but one before." To stock-raisers and dairy-farmers it lends its aid in showing the requirements of animals, the daily waste of the animal organism. It ascertains the composition and relative feeding-values of cattle-foods. It analyzes animal products, indicating their comparative worth. Chemistry stamps the value upon artificial fertilizers.

In the by-paths of agriculture, too, chemistry is of service. The intelligent investigator in the important subjects of insecticides and fungicides must prosecute his studies by the light of chemistry. And so we might proceed, but space forbids. Let us, however, remember that history emphatically shows that agriculture and agricultural chemistry have progressed with equal strides, and that for the future the indications are that the relationship of these two will be still closer.

If in this short sketch our claim is made good, then we perceive that it is of paramount importance that agricultural chemistry should form part of the education of every boy destined for the farm. Every public school in rural districts should teach it, not merely theoretically, but practically. All the officers of our experiment stations should have a knowledge of its principles, since no department of agriculture is independent of it. They at present are not only investigators but are also the teachers of the adult and practising farmer. How necessary it is then that all their work should be guided by an intimate acquaintance with that science which is not only the foundation of agriculture, but whose laws govern its operations.

THE REAL MOTIONS OF THE FIXED STARS.

BY PROFESSOR A. W. WILLIAMSON, AUGUSTANA COLLEGE, ROCK ISLAND, ILL.

IT is very often stated in newspapers, and also stated in a number of text-books on astronomy, that 1830 Groombridge has a greater velocity than the attraction of all known bodies in the universe could give it. We know not how many dead suns may exist, retaining their full power of attraction, though no longer giving light.

We do not, however, need this supposition to account for the velocity of 1830 Groombridge. Granting the laws of gravitation universal, we are able to account for any finite velocity, the attracting bodies possessing any finite degree of brightness, by supposing these bodies sufficiently large and distant.

Imagine a grand central sun just as dense as ours and a quintillion times as bright, in proportion to its surface. Suppose its distance 10^{72} times that of our sun. Suppose its periodic time 10^{54} times that of our earth. Its mass would be $(10^{72})^3 \div (10^{54})^2 = 10^{216} \div 10^{108} = 10^{108}$ times that of our sun. Its radius would be $\sqrt[3]{10^{108}} = 10^{36}$. Its apparent surface would be $(10^{54} \div 10^{36})^2 = (10^{18})^2 = 10^{36}$ times less than our sun. Its brightness would therefore be $10^{-36} \times 1$ quintillion $= 10^{-18}$ or .000000000000000001 part of that of our sun, that is, it would be as much fainter than an ordinary star as the star is fainter than the sun, invisible even by the Lick telescope.

Our system would therefore move in its orbit around this central sun as many times more rapidly than the earth moves in its orbit, as the diameter of the orbit is greater, divided by the number the periodic time is greater, that is $10^{72} \div 10^{54} = 10^{18}$. As our earth moves over eighteen miles in a second, our system must, on this supposition, move over eighteen quintillion miles in a second, or about one hundred trillion times the velocity.

It is difficult to conceive that so great a sun can have any real existence, and still more difficult to imagine we are moving with such velocity. It seems to me, however, not improbable that as the motion of the planets in their orbits is much greater than that of their satellites, so the motion of the stars around the common centre is far more rapid than that of the planets around our sun. It seems quite likely that all are moving in the same direction, and that the apparent motions of those having a sensible parallax are only the differences of their true motions. The sun may appear to be moving towards Hercules because it is moving in that direction more rapidly than the average of the stars. May it not also be the case that it is really moving in exactly the opposite direction but more slowly than other stars?

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Ancient Libyan Alphabet.

PROFESSOR KEANE in *Science*, Sept. 23, having acknowledged that he referred to the wrong book, should have been ingenuous enough to say that, in the book he did refer to, the primary form given of every letter in the Libyan alphabet is rectilinear, or a dot. As he was not, I offer to place the book in the hands of the editor of *Science* for anyone to convince himself that this is the case.

It is a strange misapprehension of the most important point at issue on the part of Professor Keane, to call the form of the letters "of secondary importance." Their disputed origin can be ascertained only by discovering their original forms.

If Professor Keane had further been ingenuous enough to state *why* Hanoteau likens the writing of the Touaregs to Arab and Hebrew, he could not have ventured the perfectly incorrect inference he fathers on Hanoteau, that it is "Semitic." Hanoteau refers solely to his belief that the Touareg writing is always read from right to left; in which opinion he was wrong, as I have plenty of documents in *tifinar* to show.

I shall say nothing further of Professor Keane's view of the pronunciation and meaning of the word *tifinar* than that every derivation I can find of it by French scholars regards the initial *t* as part of the radical; which would effectually dispose of the fanciful hypothesis that it comes from *Phœnician*.

D. G. BRINTON.

Media, Penn., Sept. 27.

Twins Among the Indians on Puget Sound.

TWINS among the Indians of Puget Sound are very uncommon; but in former times, when any did appear, they had an exceedingly hard time, as the Indians were superstitiously afraid of them. During the past eighteen years, I have known of but one pair among the Twana Indians, and one pair among the Clallams. The Twanas were well taken care of, as the parents had always lived on the reservation, where the Indian agent had previously had a pair; and so they had had an opportunity of seeing the white customs in regard to them. These parents had also been educated in school, and were quite civilized. To all intents and purposes they were white, and so nothing was done about them except that there was some talk about the former customs in regard to them.

But the pair among the Clallams did not fare so well. Their parents were old-fashioned Indians, were surrounded by old-fashioned Indians, were about eighty miles from the reservation, and they had never had a home on it. The home of their parents was in Fort Discovery, but they were at Neah Bay, catching seals, about eighty miles from home at the time the twins were born. Immediately the Neah Bay Indians became afraid of them, and quickly drove them and their parents away, as they were afraid that the twins would scare all the fish away from their waters. Accordingly, the parents returned to Port Discovery on a steamer, though the Indians were quite unwilling to have them go in that way, fearing that they would frighten all the fish away; and earnestly wished them to walk the entire distance, over mountains and through the forests or on the beach, although there was neither beach or road much of the way.

When they reached home, some of the old Indians of their own tribe were very much afraid. They threatened to kill one of the twins, so that the father did not dare to leave home. Hence he could not go off and work and earn food; neither would they allow him to fish near his home, although the fish at that time were very abundant there, for fear that all the fish would leave. Hence the man was greatly troubled to get food enough for his family to keep them from starving. They told him to live on clams. They would not go near his house if it could be avoided, and, if they had to pass it, would make quite a detour around.

It is said that long ago, when such an event occurred, the other Indians drove the fortunate or unfortunate mother into the woods with the twins, — the father going also if he wished, — and there they had to live alone, and they were not to return as long as both twins were alive; one must be disposed of in some way. If any friends pitied them enough to furnish them with food, it was carried to some place where the parents were not present, and then, when the carrier had retired, the parents could take it to their lonely home.

Other tribes on the Pacific coast had somewhat similar customs, while others honored the twins greatly, according to the reports of the British Association for the Advancement of Science, which speak of them in British Columbia, and Power's "Tribes of California," which speaks of them in that State. M. EELLS.

Union City, Wash., Sept. 12.

Prevention of Cholera Asiatica.

IN an article on "Prevention of Cholera Asiatica," printed in *Science*, September 23, I wished to give a way to detect the bacillus; inadvertently stating Gram's solution colored the germ, — it does *not* do so, — but that fact forms one of its distinguishing characteristics. However, the cholera (comma) bacillus is colored by a watery solution of fuchsin, HUGH HAMILTON.

Harrisburg, Pa., Sept. 24.

A Large Southern Telescope.

THE wide interest in astronomical research is well illustrated by the frequent gifts of large telescopes to astronomical observatories by wealthy donors who are not themselves professional students of astronomy. The number of these gifts is continually increasing, and in no department of science has greater liberality been displayed. Unfortunately, the wisdom shown in the selection of good locations for the telescopes has not equalled the generosity with which they have been given. Political or personal reasons, rather than the most favorable atmospheric conditions, have in almost all cases determined the site. These telescopes have been erected near the capitals of countries or near large universities, instead of in places where the meteorological conditions would permit the best results to be obtained. The very conditions of climate which render a country or city great, are often those which are unfavorable to astronomical work. The climate of western Europe and of the eastern portion of the United States is not suited to good astronomical work, and yet these are the very countries where nearly all the largest observatories of the world are situated. The great number of telescopes thus concentrated renders it extremely difficult for a new one to find a useful line of work. The donor may therefore be disappointed to find so small a return for his expenditure, and the opinion has become prevalent that we cannot expect much further progress in astronomy by means of instruments like those now in use. The imperfections of our atmosphere appear to limit our powers, and are more troublesome relatively with a large than with a small telescope. Accordingly, it has not been the policy of the Harvard College Observatory to attempt to obtain a large telescope to be erected in Cambridge. In order to secure the greatest possible scientific return for its expenditures, large pieces of routine work have by preference been undertaken, which could be done with smaller instruments. These conditions are now, however, changed. A station has been established by this Observatory near Arequipa, in Peru, at an altitude of more than eight thousand feet. During a large part of the year the sky of Arequipa is nearly cloudless. A telescope having an aperture of thirteen inches has been erected there, and has shown a remarkable degree of steadiness in the atmosphere. Night after night atmospheric conditions prevail which occur only at rare intervals, if ever, in Cambridge. Several of the diffraction rings surrounding the brighter stars are visible, close doubles in which the components are much less than a second apart are readily separated, and powers can be constantly employed which are so high as to be almost useless in Cambridge. In many researches the gain is as great as if the aperture of the instrument was doubled. Another important advantage of this station is that, as it is sixteen degrees south of the equator, the southern stars are all visible. A few years ago a list was published of all the refracting telescopes having an aperture of 9.8 inches or more (*Sidereal Messenger*, 1884, p. 193). From this it appears that nearly all of the largest telescopes are north of latitude + 35°, although this region covers but little more than one-fifth of the entire surface of the earth. None of the seventeen largest and but one of the fifty-three largest telescopes are south of this region. Of the entire list of seventy-four, but four, having diameters of 15, 11, 10, and 10 inches, are south of + 35°. The four largest telescopes north of + 35° have apertures of 36, 30, 29, and 27 inches, respectively. But few telescopes of the largest size have been erected since this list was prepared, and the proportion north and south is still about the same. It therefore appears that about one-quarter of the entire sky is either invisible to, or so low that it cannot be advantageously observed by, any large telescope. The Magellanic clouds, the great clusters in Centaurus, Tucana, and Dorado, the variable star η Argus, and the dense portions of the Milky Way, in Scorpius, Argo, and Crux, are included in this neglected region. Moreover, the planet Mars when nearest the earth is always far south. The study of the surface of this and of the other planets is greatly impeded by the unsteadiness of the air at most of the existing observatories. Even under the most favorable circumstances startling discoveries — relating, for example, to the existence of inhabitants in the planets — are not to be expected. Still, it is believed that in no other way are we so likely to add to our knowledge of planetary detail as by the plan here proposed. The great aperture and focal length and the steadiness of the air will permit unusually high magnifying powers to be employed, and will give this instrument corresponding advantages in many directions, — for instance, in micrometric measures, especially of faint objects. It can be used equally for visual and photographic purposes; and in photographing clusters, small nebulæ, double stars, the moon, and the planets, it will have unequalled advantages.

A series of telescopes of the largest size (including four of the six largest, the telescopes of the Lick, Pulkowa, U. S. Naval, and McCormick Observatories) has been successfully constructed by the firm of Alvan Clark & Sons. But one member of the firm now survives, Mr. Alvan G. Clark; and he expresses a doubt whether he would be ready to undertake the construction of more than one large telescope in the future. The glass is obtained with difficulty, and often only after a delay of years. A pair of discs of excellent glass suitable for a telescope having an aperture of forty inches have been cast, and can now probably be purchased at cost, $16,000. The expense of grinding and mounting would be $92,000. A suitable building would cost at least $40,000. If the sum of $200,000 could be provided, it would permit the construction of this telescope, its erection in Peru, and the means of keeping it at work for several years. Subsequently, the other funds of this Observatory would secure its permanent employment. Since a station is already established by this Observatory in Peru, a great saving could be effected in supervision and similar expenses, which otherwise would render a much larger outlay necessary.

An opportunity is thus offered to a donor to have his name permanently attached to a refracting telescope which, besides being the largest in the world, would be more favorably situated than almost any other, and would have a field of work comparatively new. The numerous gifts to this Observatory by residents of Boston and its vicinity prevent the request for a general subscription; but it is believed that if the matter is properly presented, some wealthy person may be found who would gladly make the

requisite gift, in view of the strong probability that it will lead to a great advance in our knowledge of the heavenly bodies. Any one interested in this plan is invited to address the undersigned.

Edward C. Pickering,
Director of the Observatory of Harvard College.
Cambridge, Mass., U.S.A., September, 1892.

Naltunne Tunne Measures.

When the writer was at the Siletz Agency, Oregon, in 1884, he obtained the following units of measurement from Alex. Ross, the chief of the Naltunne tunne, an Athapascan people:—

1. The double arm's length, from the meeting of the tips of the thumb and forefinger of one hand to the meeting of the tips of the thumb and forefinger of the other hand.

2. Single arm's length, "one arm," extending from the tip of the middle finger along the extended arm to the shoulder-joint.

3. From the middle of the sternum along the extended arm to the meeting of the tips of the thumb and index finger.

4. From the inner angle of the elbow to the meeting of the tips of the thumb and index finger.

5. From the middle of the fore-arm to the meeting of the tips of the thumb and index finger.

6. From the first wrinkle of the wrist to the meeting of the tips of the thumb and index finger.

7. The width of the hand (when grasping a stick), "one grasp," equal to the width of four fingers (No. 11).

8. One finger width. 9. Two finger widths. 10. Three finger widths.

11. Four finger widths (the hand being open), equal to No. 7.

12. Five finger widths (including the thumb).

13. From the joint of the right shoulder horizontally across the body to the meeting of the tips of the thumb and forefinger of the extended left arm.

14. From the tip of the right elbow (the right arm being bent and held horizontally, the hand touching the shoulder) horizontally across the body to the tip of the middle finger of the left hand, the left arm also being extended horizontally.

J. Owen Dorsey.
Takoma Park, D.C., Sept. 13.

Omaha Arrow-Measure.

The Omaha use the following as their arrow-measure: From the inner angle of the elbow to the tip of the middle finger, and thence over the back of the hand to the wrist-bone.

J. Owen Dorsey.
Takoma Park, D.C., Sept. 13.

BOOK-REVIEWS.

Elementary Text-Book of Entomology. **By W. F. Kirby. Second Edition. Revised and augmented. Ill. New York, Macmillan & Co. 281 p. 8°. $3.**

Entomologists everywhere will welcome with pleasure this new edition of Kirby's handbook of reference to the study of insects. As compared with the first edition of the work, we find the present one improved by the addition of a carefully prepared index, and by an appendix and table of contents. The appendix adds considerable new and valuable matter, while the last-named feature answers admirably to present the main divisions of the classification of insects used by the author. Various schemes of the latter are briefly discussed in the introduction, but our space will only admit of our saying here that seven orders are adopted to which the lesser groups of all insects are referred. These are the *Coleoptera* (including *Strepsitera*), *Orthoptera* (including *Euplexoptera* and *Dictyoptera*), *Neuroptera* (including *Trichoptera, Thysanura, Collembola, Mallophaga,* and *Thysanoptera*), *Hymenoptera, Lepidoptera, Hemiptera* or *Rhynchota* (including the sub-orders *Hemiptera — Heteroptera* and *Hemiptera — Hemoptera,* and the *Anoplura*), and *Diptera* (including *Aphaniptera* and possibly *Achreioptera*). Our author tersely defines these several

Publications Received at Editor's Office.

Dobbin, L. and Walker J. Chemical Theory for Beginners. New York, Macmillan & Co. 16°. 244 p. 70 cts.
Geological Survey of Texas. Annual Report, 1891. Austin, State. 8°. Paper. 470 p.
Kirby, W. F. Elementary Text-Book of Entomology. New York, Macmillan & Co. 8°. 282 p. Ill. $3.
Wilkinson, George. The Voice. 16°. Paper. 72 p.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale or Exchange.—The subscriber would like to receive cash offers, or an offer in exchange for the earlier volumes of Poggendorf's Annalen and the later volumes of Silliman's Journal, upon the following list: Chenu—Manuel de Conchyliologiè. 2 vols. Nearly 5,000 figures, some hand-colored. Paper. Paris, 1859. Edwards.—Butterflies of N. A. 2 vols. Plates hand-colored. Vol. I., half calf Vol. II. in parts. Leyman, Agassiz, Hagen.—Ills. Cat. Mus. Comp. Zoel. at Harvard. No. I. Ophiuridae. No. II., Acalephae. No. III., Astacidae. All bound in one volume. American Naturalist. Vols. I.–VII. Cloth. Silliman's Am. Jour. of Science and Arts. Third Series. Vols. I.–X. Cloth. Binney.—Terrestrial Mollusks of N. A. Colored plates. 4 vols. Stretch.—Zygaenidae and Bombycidae of N. A. Colored plates. Also a considerable library of monographs, reports, and scientific books, and a large number of duplicates of fossils, minerals and shells. E. A. STRONG, Ypsilanti, Mich., Sept., 1892.

Exchange.—I have the finest shells of Anodonta corpulenta, C'p'r, and Suborbiculata, Say, in the world. Will exchange for fresh water, land, and marine shells, in large or small quantities. Have also for exchange 50 varieties of fresh water and land shells from Spoon River, Ill. Dr. W. S. STRODE, Lewistown, Ill.

To exchange for books on birds or insects, or for back volumes of American Naturalist: Ecker's "Anatomy of the Frog," Packard's "Guide," Guyot's "The Earth and Man," Rockhill's, "The Land of the Lamas," Parker's "Biology," Shoemaker's "Heredity, Health and Personal Beauty," Dexter's "The Kingdoms of Nature," all new. M. J. ELROD, Ill. Wes. Univ., Bloomington, Ill.

For Sale.—About 1087 volumes of the private library of Dr. Nicolas León, formerly director of the Museum at Morelia, embracing publications of special value for Mexicologists, like those of Bishop Zumárraga (16th century), of Siguenza y Gongora, of Aleman, etc., the Missal of Spinoza, all very scarce; manuscripts on the history of Michoacán and other Mexican States, on the Tarasco (the Indian language of Michoacán) and several works, of which the only copy known to exist is in this collection. Parties interested in the sale please address Dr. NIC. LEÓN, Portal de Matamoras, Morelia, Mexico.

Wants.

METALLURGICAL CHEMIST will give instruction in the metallurgy and chemical analysis of iron and steel. Complete or special courses applying to the manufacture of pig irons and steels, as well as to their uses. Address "METALLURGIST," care Science.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems, fossils, shells, archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Hortter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.

WANTED.—A position as zoological artist in connection with a scientific expedition, institution or individual investigations. Experienced in microscopic and all scientific work. References given if desired. Address J. HENRY BLAKE, 7 Prentiss Place, N. Cambridge, Mass.

CHEMIST AND ENGINEER, graduate German Polytechnic, Organic and Analytical, desires a position in laboratory or chemical works. Address 213½ E. 7th Street, New York, care Levy.

A MAN, 36 years old, of extensive experience, having the degrees of A.M. and Ph.D., desires a first-class opening as a teacher of Zoölogy and kindred studies in a college or university. Can furnish numerous testimonials or references as to success and skill in most modern laboratory methods. Address E. W. D., Md. Agr. College, College Park, Md.

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

A YOUNG MAN, with a thorough training in Analytical Chemistry (including analysis of minerals, food, water, etc.), and holding a diploma of the School of Practical Science, of Toronto, and good testimonials, desires a position as Analytical Chemist or as assistant to such. Address to WM. LAWSON, 16 Washington Ave., Toronto, Ontario.

groups under their respective heads, in the various divisional chapters of the books which they constitute, while the minor groups below orders are treated under sections of these chapters with more or less detail.

Mr. Kirby, being an Englishman and a member of the British Museum staff, it is no more than natural that in his volume he has given British entomology especial consideration, but in so doing he has hardly impaired its value for a text-book to the science of the entire subject. Indeed, the American entomologist's library will be lacking a most useful auxiliary to monographic treatises unless possessed of a copy of this manual. Of all the species making up his seven orders, he states that no less than 12,600 are to be found in Britain, as compared with the 270,000 making up the insect fauna of the world. We see the book's greatest weakness in his introduction, where not sufficient attention has been given to the anatomy of insects, their study from a general standpoint, their distribution in time, their taxonomy and similar matters, all of which give the works of Packard such a peculiar value. Not a single cut illustrates the fourteen pages devoted to his introduction in a volume of nearly three hundred. On the other hand, it would be hard to accord too much praise to the 650 figures contained on 87 plates that embellish the book. To the general student, as a means of diagnosis of the main groups, they must prove of the very greatest assistance, portrayed as they are with marked accuracy, strength, and clearness. For the purpose mentioned, the *Coleoptera* are especially good, bold, and well drawn, though perhaps lacking in that refinement of detail which lends such beauty to the productions of Riley's pencil. Throughout the pages of Mr. Kirby's work we are pleased to find that he has not altogether neglected to consider the economic importance, or the reverse, of many insects to the agriculturalist, and to vegetation, forests, and plant-life, generally — a department now attracting such universal attention in this country.

Upon the whole, we may say that this handsomely gotten-up manual presents but little for adverse criticism, when we come to consider what the volume aims to give, while it offers a great deal to commend it, and it is a work that any entomologist in this country will be proud to see upon the shelves of his library, as it is one that the student of entomology will be constantly called upon to consult. R. W SHUFELDT.

Primitive Man in Ohio. Vol. I. By WARREN K. MOOREHEAD. New York, G. P. Putnam's Sons. 246p. 8vo. Illustrated.

THE problem, Who were the mound builders? has long been one which has interested students of the antiquities of the valley of the Ohio, without much unanimity of conclusion on the part of those who undertook to answer it. Whoever these ancient peoples were, Mr. Moorehead and his collaborators in the work before us have been enabled by a series of admirably conducted investigations to throw a new light on their arts and institutions. These collaborators are Mr. Gerard Fowke, Dr. H. T. Cresson, and Mr. W. H. Davis; each of whom contributes one or two chapters to the book, on special fields.

After an opening chapter on palæolithic man, there are descriptions of excavations in various sites, the most celebrated of which are Fort Ancient, Madisonville, and Hopewell's Tumuli. The discoveries in the latter were especially rich, and will figure prominently in the archæological department of the Chicago Exhibition. They are particularly interesting as indicative of an extended use of metals, notably copper.

An examination of the skulls unearthed shows the contemporary existence of two groups, the one short-headed, the other long-headed; or, are they simply two cranial forms within the same population? This seems quite as likely.

The illustrations in the work are faithfully and well executed from the objects, and add both to the beauty and utility of the volume.

TO THOSE INTERESTED IN SCIENCE.

[Science (weekly) established in 1883, N. D. C. HODGES, 874 Broadway, New York City.]

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

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Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
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Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

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SCIENCE

NEW YORK, OCTOBER 7, 1892.

IS THE MAYA HIEROGLYPHIC WRITING PHONETIC?

BY PROFESSOR CYRUS THOMAS.

I HAD not expected to ask any more space of *Science* at present for the further discussion of this subject. Nevertheless, as the interpretation of the aboriginal codices and inscriptions is now the most desirable thing relating to North American archæology, a few more pages may perhaps be profitably devoted to the subject, if confined to an earnest endeavor to arrive at the truth.

I have asserted that I find the Maya hieroglyphics to be in part phonetic, and that I have ascertained the interpretation of a sufficient number to form a key to the solution of the problem. This statement I firmly believe I can maintain, and trust I will be able to do so in the paper I am preparing for publication by the Bureau of Ethnology. In the meantime I have the kind permission of the Director, Major Powell, to present through the public press such samples as may be deemed sufficient to afford those working in the same field an opportunity of judging of the correctness of my claim. As Dr. Seler has (in *Science*, Aug. 26) seen fit to question this claim, some additional evidence is presented in this paper. I regret to say, however, that his criticisms appear to have been offered without proper consideration and to be based to a large extent on assumptions backed by no proofs.

As the attempt to reply to mere assumptions would drift the controversy into statements of personal opinions, simple reference to some of these and to some of his mistakes will suffice.

He asserts that the second element of the symbol interpreted *Cutz* (his Fig. 19) is not given in my letter-list, when in truth it is number 24 of that list. Referring to my interpretation by 2-*Yaxkin*, of his Fig. 29, he says it "is obviously erroneous," as "there does not exist a numeral designation with crosses between the dots;" when a dot and two crosses with a month symbol form a date in the bottom line of plate 49 Dresden Codex, — 1 Mac. His statement that the first glyph shown in my Fig. 2, p. 46, is the same as that in certain groups he mentions, and as his Figs. 31–33, is incorrect, as he has failed to include the prefix. The character in his 31 is the same as my figure, but his 32 and 33 are different, as here the prefix, which is materially different from the others, forms part of the symbol and gives a different word. If I am right in my interpretation of this prefix by *ha*, it is possible, — although the translation this gives to the combination is not found in any lexicon I have at hand, —that the signification is suggested by *haɔab*, "a sword, weapon to wound with, whip,"— Henderson (MS. Lexicon in possession of the Bureau of Ethnology) adds "rod." This agrees very well with what we see in the hands of the figures below, and also with what seems to be the general tenor of the series.

Dr. Seler is correct in stating that the sign of aspiration (his Fig. 16) found in Brasseur's "Landa," is not in the original text; nevertheless, we have to thank the Abbé for a happy suggestion. But his assertion that it is a substitute for the character shown in his Fig. 17 cannot be accepted, as both (16 and 17_b) are found connected with the same glyph, as in Troano 17 and 16 and in Dresden 26 and 28. I may add that Dr. Seler has gone farther than Brasseur, as he has given us in his 17_a a character which appears to be new,— at any rate I have been unable, by a careful search, to find it in any of the codices. It occurs in the general form given, but I have failed to find it with the two little interior dots and parallelogram. In a very few instances the parallelogram is present, but never the dots,—usually the only mark in the circle is a short curved line. These differences are minute but important. As yet I have been unable to interpret this character, but think *u* is its chief element.

Speaking of the *e* symbol, he says "it occurs in various compound hieroglyphics" as those shown in his Figs. 26–28. His 26 (from Troano 31*) he says "refers to the rope trimmed with thorns (!) that the penitent used to draw through the pierced tongue." It would seem from this that he has taken the marks showing the twisted strands for thorns, as there is absolutely nothing else in the figure which could possibly suggest this idea. A moment's thought would have reminded him that, if the artist intended to show thorns, he would have projected them from the sides as in Charnay's figure to which he refers. The second part of his Fig. 26 is an *e*, the whole symbol (our Fig. 10) is probably correctly rendered by *Xel* (or *Xelem*), "to part, separate, cut, divide." The left member of the symbol has *x* as its chief phonetic element, but generally, as it seems, with *m* as a subordinate consonant sound. This interpretation agrees much better with the figures below the text than Dr. Seler's suggestion; and when we add that the character to the left of it (our Fig. 9) is to be interpreted *Zum* or *Zuum*, "rope, cord, line" (see the *m* in my letter-list), there is perfect agreement between the text so far as rendered and the figures, and the interpretations are all consistent with my letter-list. Referring to our Fig. 6, we have the two chief elements of these symbols combined in the word *Xamach*, "a vessel" which is found in more than one place accompanied by a vessel (see Codex Cortez 27).

It is by no means, as he claims, a "curious coincidence" that three words, expressing as many different actions, "should all contain an *e*." In fact, each of the three English words Dr. Seler uses to express the actions referred to — "pierce," "weave," "embroider" — contains two *e*'s. This objection on his part is therefore frivolous.

When he points out with perfect assurance "the prey-gods of the five regions," the "hunting god," "the dog of heaven that carries the lightning," and marks as stones what one at a single glance ought to recognize as the ends of cross-beams, or "weight-poles" with the wood symbol *Che* on them, it seems (and I say it with due regard to courtesy) unprofitable to attempt to follow him. To assume that his Fig. 29 is a variant of 30 is certainly straining a point to the utmost tension. Nor is he correct in stating that 30 is the glyph I interpreted in a former communication, "moisture"—that character was from the Cortesian Codex, p. 32. True, the parts are similar, but the details and surroundings are different. *Y'b*, as we have not learned the determinatives which indicate the vowel sounds, may be *Yeeb* "moisture" (Cortez 32); *Yib* "to liquefy or melt" (as honey, Troano 3*); *Yib* (or *Yb*), "a bean" or "beans" (his Fig. 30 and Dresden 18 and 19); we must therefore decide by the accompanying figures and details. A more thorough study and comparison of the characters will perhaps enable us ultimately to find the determinatives. The little crosses over 29 and 30 may have been placed there as helps in this respect; of this, however, I am unable to speak with any confidence, nor do I feel entirely satisfied with the rendering *Yax-kin*, although the parts are *Y'* and *kin*, and Dr. Seler's objection is not tenable.

He speaks of the fourth character of my Fig. 4 as being the same as a number of other characters he refers to, particularly the series on Troano 35* and Cortesianus 22. And he says "it is scarcely probable that in all these cases the reading *Xaan* should correspond to the matter expressed." It is apparent from this that he has overlooked a minute but important particular in that interpreted by me, which occurs but very few times in the codices. The little item at the front of the face, which is a very essential portion of the glyph, has not been carefully examined by him or he would not have fallen into the error of considering

those mentioned as the same. He had but to look to Fig. 3, same article, to see a difference, but he seems to have criticised the article without having thoroughly read it. There are a number of variations in this little character, whereby different words, as *Xaan*, *Xan*, *Xocaan*, *Xolcin*, *Xolan*, etc., are indicated. See, for example, Troano 4^*_c, 5^*_c, 7^*_b, 30^*_c, 31^*_c, 33^*_b, 32^*_c, 14_c; Dresden 4_b; all of which differ from one another. I must confess that his eyes are sharper than mine if he can find any figures in either of the codices representing a god or any one else beating a drum. This, like other of his assertions in regard to the significance of other figures, appears to be "merely hypothetical."

His assertion that Landa's first *a* is the head of the turtle, I think correct, as I long ago suggested (6th Rep. Bur. Eth., p. 348). I think he is also correct in assuming, as I had previously done, that his Fig. 6 indicates the Quetzal, and his Fig. 8 the *Moo* or large parrot (same report, pp. 355 and 356).

Dr. Seler, in closing his criticisms, expresses the opinion that "it would be far more appropriate to point out the real meaning as to the matter expressed, of each glyph."[1] How are we to determine this real meaning? And by what evidence are we to verify our conclusions? His efforts in this direction appear to be far from satisfactory and lack that proof which brings conviction — in fact, in most cases are "merely hypothetical."

That the writing is largely phonetic can, I think, be proved without the interpretation of a single character. First, we have the statement of the early Spanish writers to this effect, Landa backing his assertion by an attempt to give the letter elements, and by a full series of the day and month symbols, which are verified by the codices. It is not likely that he was wholly in error in regard to the main fact where so many of the details have been verified. It appears from a statement by Father Alonso Ponce, quoted by Dr. Brinton,[1] that these characters were actually used by missionaries to impart instruction to the natives. In fact, the author quoted says "some of our priests understood and knew how to read them and also to write them." The internal evidence appears to confirm this view. The evident use of the same prefixes and suffixes to different characters leads to this conclusion. The fact that supposed deity symbols are very frequently followed by particular characters which may be supposed to indicate certain attributes is another evidence on this point. Other indications of phoneticism are found in the various combinations of the different elements; the use in some places of a seemingly conventional symbol to indicate an object (for example, the head of a figured bird) while in other places a character bearing no resemblance to the object is used; the fact that the terminal elements of the symbols for east and west are alike, and the final syllables of the words are the same, and also that a like repetition of elements is found in some of the month and day symbols where the sound is repeated,— *Cib, Caban; Pax, Chichan; Yaxkin, Yax*. Phoneticism appears, also, to be indicated by the fact that different characters are used to indicate certain months. Finally, the general character of the writing seems to forbid the idea that it consists of merely conventional symbols or that it can be explained on any theory short of a degree of phoneticism.

Assuming that it is phonetic, we are justified in making attempts at interpretation, but these to be successful should, I think, be based largely on certain considerations which will aid in obtaining correct solutions. Of course, the chief reliance is on the fact that the parts give appropriate results in new combinations, but the considerations I mention will furnish some aid in the work.

First, it is apparent to all careful students of these codices that they are formed upon a conventional plan. This is found to be, in general, as follows: What may be called a series or chapter is preceded by one or more columns of day symbols, over which are the numerals to be attached to them. From these, running along to the right, immediately below the text, is a series of black and red numerals, indicating certain days, as explained in my "Aids to the Study of the Maya Codices" (6th Ann. Rep. Bur. Eth., pp. 275–283). It is apparent from this order, the subdivisions of the plates, the arrangement of the pictures below the text, and the method of grouping the written characters (see "Study MS. Tro.," pp. 137–138) that the subject of the text (usually arranged in groups of four or six compound characters over a pair of numerals, one red and one black) refers in some way to the day or period represented by these numerals. Second, very many of the pictures show masked individuals who represent certain deities or characters. Even where these pictures refer to the manners, customs, and industries of the people, the mask is usually worn by the male. As the forms of these masks are comparatively limited in number, we soon learn, by the repetition of certain characters in connection therewith, the symbols which denote these personages (or deities, if such they be). Third, there is often a certain parallelism in the groups of a series, which will, in some cases, enable us to determine the general subject of a series where but one or two characters can be deciphered. It will also, in some cases, enable us to decide with every assurance of being correct what certain characters of the series specifically refer to. This, as every one can see, is a great help in the attempts to decipher the text. Fourth, the general subject of certain series may

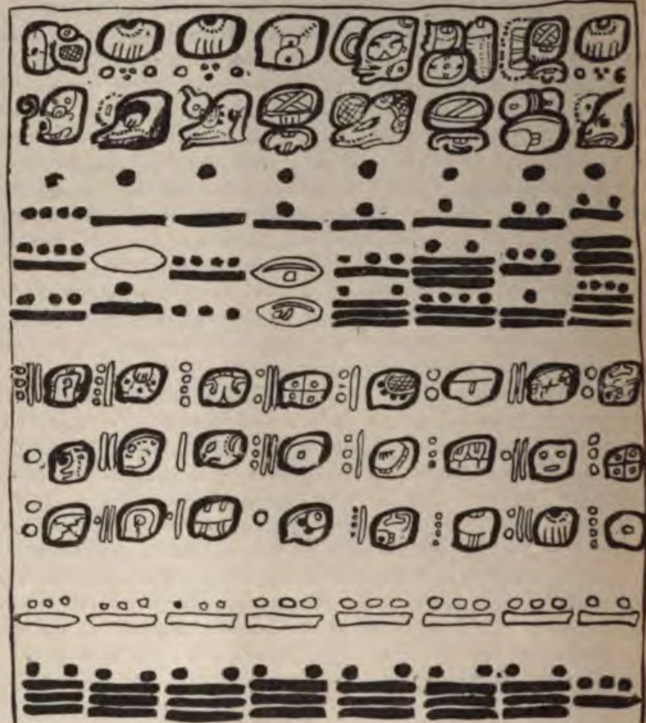

FIG. 1.

be inferred from the pictures; nevertheless, great caution is necessary in using this aid, as the Indian method of representing by figures ideas and actions was far different from that which would be adopted at the present day. The interpretation of a single character of a series will sometimes cast to the winds the conclusion we had reached in regard to the subject referred to. Fifth, the postures and clothing of the human figures represented and other details make it evident that the people were Indians in the full acceptation of that term; a fact which should lead us to the conclusion that the purport of the text is of that grade of thought and expression characteristic of the Indian culture-status. Sixth, the natural history and physical conditions and characteristics of the peninsula of Yucatan must be borne in mind; and, lastly, the historical evidence must be referred to, especially Landa's "Relacion."

To illustrate the aid afforded by the first of the foregoing items and at the same time give interpretations of some characters reference is made to Fig. 1, which is the lower half of Pl. 55 of the Dresden Codex[2]. For the benefit of readers not familiar with the codices, we may state that the two upper transverse lines are glyphs forming the text; the four lines next below, of black dots

[1] Maya Chronicles, p. 63.

[2] A copy of the full plate is given on page 310 of the 6th Am. Rep. Bur. Eth.

and short lines, are numerals; the next three lines are day characters with accompanying red numerals; and the two lower lines are numerals (the outline or hollow numerals are red in the original). Taking the series by columns, we observe that each pair of glyphs, reading downwards, has its own series of numerals and day symbols. Hence we conclude that each pair forms a sentence, and that here the reading is downward or by columns.

Taking the left-hand column, we interpret it as follows, beginning with the character at the top: *Kilchalac*, "Malignant ulcer, sore, or wound." The next character below, *Bancimil*, "Pest, mortality, fatal epidemic." Before proceeding, it is necessary to remark that the first character as given in the figure is slightly erroneous. The little circle over the hatched portion has, in the original, the little parallelogram and two dots characteristic of the *l* (see *Science*, July 22, 1892, p. 44, Fig. 1, No. 13c). Continuing downwards we have next one dot = 1, then four dots = 4, then a short line and four dots = 9, then a short line and three dots = 8. Next is 13Cib, then 1Caban, then 2Ezanah, three days with their accompanying numbers. Lastly, below these we have the red numeral, 8, and black numeral, 17, denoting 8 months and 17 days, the period which intervenes between two columns. It is only necessary to say here that the black numerals immediately below the text in this column denote 24 years, 9 months, and 8 days (see explanation in "Aids to the Study of the Maya Codices," 6th Ann. Rep. Bur. Eth.).

As this series, which runs through several plates, is divided, with few exceptions, into periods of 8 months and 17 days, it is reasonable to assume, if the text bears any relation thereto, that the portion of the text in a given column refers to something occurring in the period of 8 months and 17 days denoted by the lower numeral symbols. This gives us a clue to the signification of the two written characters at the top, which, taken in connection with what follows below, may be read "At this time occurred the deadly ulcer pest."

Very often, in addition to the general aids above mentioned, we find special aids relating to particular cases. This is true in this instance. We observe to the left of the face of the second character, a small corkscrew figure which, according to our interpretation, must have *b* as its chief phonetic element. If we look below in the same column at the symbols for *Cib* and *Caban*, we see the same corkscrew figure in each, and find *b* as a phonetic element of each.

Turning next to the third column from the left of our figure, we observe that the upper character is the second *M* symbol of our letter-list (*Science*, July 22) and that immediately below it are five dots. As *Ho* is the Maya word for "five," we may translate the whole symbol by *Homah*, "To submerge, overwhelm, beat down and destroy dwellings and other things, and to unroof houses." The second character is slightly incorrect in the figure, as it lacks a slender x-shaped figure in the right portion of the glyph; and the little figure in front of the eye of the animal-head should represent a rod passing through a little circle. This character we render by the Maya word *Chaac* or *Chac* because the head is like that of the Chac figure as shown in the Troano Codex. *Chaac* or *Chac* signifies "The tempest or tornado." Connected with the time symbols below, the interpretation will be, "At this time, or during this period, occurred a tempest which unroofed houses and destroyed dwellings." The little character in front of the eye of the second character is the lightning symbol,— the proof, however, of this must be omitted as it cannot be given without the introduction of several figures.

The two characters at the top of the seventh or next to the right-hand column, we translate as follows: *Bulzah*, "To inundate or be inundated." *Tamculul*, "Deep, profound." That is to say, "At this time the land was inundated to a great depth." The upper part of No. 2 is imperfect in our figure in not having a slight opening at the right end.

This hunting out of the lexicons Maya words to suit characters is of course mere childish play unless based upon a legitimate and scientific process.

First, from the second element in the symbols for the east and west cardinal points and of the month *Yaxkin* I obtain the hieroglygh for *Kin* or *Ki'*. This forms the first part of the character I have translated above — *Kilchalac* — and gives us the *ki* or *kil*; the little circle above (corrected as suggested) is Landa's *l*; in the hatched portion of the right character I find the *ch* which is seen in the symbols for *chicchan* and *Pax*, in one as *ch* (soft) and in the other as *x* (sh). Thus we have *kil, ch', l'*. Of the next character translated we find the *b* in the corkscrew figure in front of the face,— as seen in *Cib* and *Caban*. The *cimil* symbol is seen in the face character. The signification of the *chaac* symbol is determinable independently of its phoneticism. It is found in Dres. 71c, 72c, and 73c, where its relation to the tempest is evident. The *Ho* in *Homah* has not been verified, the dots may be, and I am inclined to believe are, used as a determinative or simply to indicate the aspirate; I can only assert positively that it is some word relating to the effect of the tempest, the principal phonetic element of which is *m*, and that the five dots below give better results as *h* than with any other phonetic element.

As the crucial test of attempts to decipher is that the characters shall give like results in new combinations, I present some specimens to show that my interpretations hold good in what seems to be a sufficient number of cases to justify or at least to furnish some basis for the claim made. The incompleteness of our lexicons and the probability that the language in which the codices are written is archaic must be borne in mind. It is, therefore, more than likely that very many cases will occur where, although we may know the chief phonetic element of each part of a compound character, we cannot interpret the whole. This will undoubtedly be true unless there are indications of the minor elements which have not as yet been discovered.

Let us take, for example, the *m* of my letter-list — shown here in Fig. 2. It is the same as the symbol of the day, *Ymix*, in which we find *m* a leading phonetic element. Fig. 3 (Dres. 50c)[1] is the symbol for the month *Mac*. It is possible and even probable that this symbol, which here varies slightly from the conventional form, should be rendered *Camach* or *Camaach*, signifying "the jaws," as this appears to be the true name of the month. I was at first inclined to believe that Landa's character for this month was but a conventional symbol probably intended to represent the mouth, but am now convinced that it is phonetic.

I have asserted in a previous communication that Landa's symbol for *ma* is correct, but I should have said that it will be correct if the strokes indicating the *m* are inserted in the little circles at the ends. In our Fig. 5, taken from the lower end of the line in Dres. 69, we see possibly the original from which this author's symbol for the month *Mac* was taken, as it is used at this point to indicate the month. Here we see these strokes very distinctly, and in the ends of the lower character the little parallelograms indicating the *a*, hence we render the symbol by *Maach*, an abbreviation of *Camaach*, as given by Perez. Is there not in this fact a very strong indication, if not positive proof, of phoneticism?

The compound character shown in Fig. 4 is found in Tro. 9*b and 10*c. It occurs in the latter twice, the parts, however, reversed in the parallel groups (as unfortunately in our figure), while in that of 9*b one part is placed above another. These variations do not necessarily indicate a difference in the phonetic value. Omitting the prefix *U*, this may be rendered *Makcab*, "To eat honey without chewing (that is, by sucking); to break into a bee-hive and steal the honey." As the parts *Cab* and *Mak* have the same signification when separate, the reversal of the parts of the symbol does not change the signification. By turning to the plates of the Tro. codex on which the symbols are found, the appropriateness of this rendering will be at once apparent. There we see the twisted red symbols denoting the fire, kindled beneath the bee-houses or hives, by which to smoke out the busy little workers. At least it is thus I interpret these figures.

Fig. 6 (Cort. 27a, Tro. 14b and c, etc.): *Xamach*, "A vessel, a large earthen pot." It is also applied to the clay vessel in which tortillas were cooked. After the introduction of metallic vessels

[1] The abbreviations, Dres. for Dresden Codex, Tro. for Troano Codex, and Cort. for Cortesian Codex, are used in the remainder of the article. The letters, a, b, c, and d, following the pages indicate the tranverse divisions beginning with *a* for the upper one.

by Europeans, it was applied to an iron plate used to bake bread upon (Henderson). In the codices it appears to have been used chiefly as the name of a jar and of vessels in which meat was cooked; see, for example, Cort. 27[a], where there are four symbols and four vessels, and a cardinal point symbol to each, probably indicating the relative positions in which they were to be placed. On Tro. 15[c] we find the same symbol occurring in five parallel groups, four of them, with a cardinal point symbol accompanying each. The middle one may be interpreted with a strong probability of being correct; *xaman xamach, theeth — ? —* ; "In the vessel toward the north the haunch or quarters — ? —." The fourth character, indicated by the interrogation point, I am unable to interpret.

Fig. 7. Tro. 17*[c]. *Chim* (*Chimil*), "A bag, sack, a kind of net." The object referred to is seen in the figure below the text, where it forms the net-like covering of the image-head in the vessel. The symbol in the same group — our Fig. 8 — which is a derivative of *Kal*, "to imprison, inclose, shut in," also corresponds with what is seen in the figure.

Fig. 9. Tro. 31*[b]. *Zum* or *Zuum*, "rope, cord, line," and Fig. 10, same group, *Xel* or *Xelem*, "to part, separate, cut, divide," have been referred to above.

lay a beam across a place, to traverse." Reference to the plate indicated will make apparent the appropriateness of this interpretation. In this symbol the *m* character is abbreviated to the upper or dot-surrounded portion alone.

As our Fig. 8 without the suffix is the well-known symbol for 20, which in Maya is *Kal*, we have two places in which the phonetic equivalent applies. The signification "to imprison or shut in" is also appropriate in Fig. 4 of my communication in *Science*, July 22, which gives us a third combination.

Now let us take the *b* character as given in my letter-list. It is given by Landa as his second *b* substantially as found in the codices; also in his symbols for the months Pop and Kayab as repeated in Dres. 46[c] and 48[c]. The following examples of its use in the codices are given with interpretations which I believe to be substantially correct. As those who are interested in the subject can make the comparisons and judge of the appropriateness of the renderings without explanations, I will make my comments brief.

Fig. 14. Tro. 12*[b]. Omitting the prefix *Ca*, I interpret *Bon* (*Bonah*), "to paint, dye, tinge, stain." Using the *Ca*, which has numerous significations, and the character which follows, shown in our Fig. 15, which we render *Xelche*, "groove or crack in the

FIGS. 2-27.

wood," we obtain the following: "Paint twice the grooves in the wood," or "the two grooves."

Fig. 11. Dres. 14[b] and [c] and 46[b]. *Maax*, "monkey, ape, imitator." The two dotted lines which fall in this symbol from the *m* character, I take to be indications of the double *a* and not of the *x*. The face, I think, is a mere conventional symbol. The personage with which this symbol appears to be connected is distinct from the dark figure which I have in a former publication assumed to be *Ekchuah*, the god of merchants, which is accepted by Rosny and Dr. Schellhas.[1]

Fig. 12. Cort. 11[b]. *Hahaymuc*, "To bury or inter superficially;" also "A stab or thrust given obliquely." The first definition applies very well to the act of planting corn shown in the figure below. The second agrees equally well with the idea of dibbling holes into the ground with the curved stick which the planter holds in his hand. Attention is also called to the fact that the sign of aspiration is duplicated in the symbol and the *h* is repeated in the word. The parallel passage in Tro. 31[b] (left group) appears to have the signification of the second of the above renderings, though different symbols. We may remark in passing that this parallelism in passages and many other things show that the Cortesianus is not a part of the Troano, but a distinct codex, notwithstanding the divided "title-page."

Fig. 13. Cort. 20[b]. *Hamah*, "To make a breach in a rampart; to break down or break open;" or *Hemeh* (from *Hem*), "To

[1] Brasseur, under *Akab-Max*, speaks of a phantom or hobgoblin of this name which he says signifies the "Great Monkey of the night."

Fig. 16. Tro. 31[d]: *Bulahaan* or some derivative of *Bul*, *Bulah*, "To submerge, overwhelm with water." The character found immediately below, shown in Fig. 17, may be rendered by *Ban* (*Banah*), "To demolish, throw down, level with the ground." As the long-nosed god (Tlaloc?) is seen below overturning a jar of water on the sprouting corn, the appropriateness of the rendering is apparent.

Fig. 18 (a and b). Tro. 3*[b]. These two characters we translate *Yib-u-cab*, "To liquefy, melt, dissolve the honey."

Fig. 19 (a–e). Tro. 35[c]. The characters *a*, *b*, *c*, *d*, *e*, which form one group, may be rendered with a probability of being correct, — following the order of the letters, — *Kuch bikyah hak — ? — ma-laah*, "The vulture moves from one side to the other with a tremulous motion in a wonderful manner — ? — without repeated buffetings." The first character of the group is not included, as it is well nigh obliterated; *a* is a conventional symbol, and I am unable to suggest the interpretation of *d*.

As our paper is necessarily limited, the above must suffice at present as examples of tracing the combinations of a single character. That those mentioned appear in numerous compound symbols which we are, as yet, unable to decipher, will be admitted; but this was to be expected, and must continue to be true until more complete lexicons of the language are obtained, or until some

one as familiar with it as with his native tongue takes hold of the work.

We will now call attention to some characters, the interpretation of which seems to give us a proper clue to the signification of the subjoined figures, sometimes very different, however, from the conclusion likely to be reached from a study of the figures (pictures) alone.

Let us take the leading symbol in the "baptismal" scene shown in Tro. 20*c. There are in this series four groups, each assigned to one of the cardinal points; this symbol, which is our fig 20, is found in each, hence must indicate some act, thought, or thing applicable to each of the figures below, which represent women apparently sprinkling children. We observe that the upper character of the symbol is the same as that of our Fig. 21, the symbol for *Chikin*, "west;" that the one below it is Landa's *H*, and that to the right his *i*. Putting these together we have *Chic-ha* (or *Chich-atah*) — *i*, or *ich*; "To rinse, cleanse, or wash with water, the child," or "the face."[1] A very simple and ordinary operation, but, like everything else which the priests could bring under control, was to be attended with certain religious or superstitious observances. Possibly this may refer to something of a more public character than the cleansing of children in the household.

In the middle divisions of Plates 24 and 25 Cortesianus, we see what we take to be a series of enclosed graves or sepulchres, the inclosure or vault being of wood fastened by thongs or withes. The dead are seen within, but on top of each a person stooping or lying down. What does this signify? Judging from the figures alone, several different and apparently equally applicable answers might be given. Referring to the text above (Plate 25), we observe the characters shown in our Figs. 22 and 23. The first (Fig. 22) we translate by *Paa-laahal* from *Pablaahal*, "To rip open, unseam; to cut, break or burst open." The second (Fig. 23) by *U-Paa Cimilhi*, "the enclosures of the dead." The article borne by the middle figure, Plate 25, appears to be the same as those in the hands of the individuals Tro. 23*c, where they appear to be used in severing the trunks of trees. Although odd-shaped implements to be used for this purpose, I have supposed them to be what may be termed saws, fitted with flint teeth. At any rate, they are used in some way in working in wood. Fig. 24, from same series, is probably a derivative of *Paaxal*, "To demolish, etc."

In Dres. 1c the figure shows two individuals drawing a seine in which is a single fish, over which is the character shown in our Fig. 25, here turned on its side as in the original. This contains the same elements as No. 3, Fig. 2, *Science*, July 22, translated *Cutz*, "the turkey," but here they are reversed. Turning to Perez's lexicon, we find that *Tzac* is a little fish so named; Brasseur says a little fish resembling a sardine which inhabits the cenotes.

As the symbol for *Xaman*, "north," Fig. 26 contains the characters for *ma* and *y* according to my theory, and lacks the *x* symbol, the question arises, How is this to be explained? That some of the day and month symbols, if phonetic, are abbreviated will become evident to anyone who will carefully study them. That the symbol for Nohol, "South," if phonetic, is also abbreviated must be admitted. The same is true of that for north. Turning to Tro. 20b, we find the symbol shown in our Fig. 27, which is here used for North. In each wing of the upper character we see the hatching indicating *x'x*; the middle one *ma*, and in the lower one the *y*. Supplying the subordinate elements we have *xax-ma-yaam*, "the side without an opening" or "door." As *Nohol* signifies "the great door," this contrast is consistent and gives us a Maya name for north, and does away with the necessity, as Charencey supposes, of resorting to a foreign language for the word.[2]

[1] Perez limits the signification of this word chiefly to rinsing the mouth, but Brasseur gives it a more general meaning.

[2] Actes. Soc. Philol., Tom. 20, p. 187.

NOTES AND NEWS.

AT last there seems to be an awakening among Americans as to the food they eat, if we may judge from the interest taken in the food exhibitions which have been held of late years. A most attractive exhibition of this kind has been opened at the Madison Square Garden in this city, and has combined with it a series of lectures, by Miss Parloa, on cooking. The exhibition ranges from a dairy — cows and all — to the toothsome buckwheat cakes. One thing brought out clearly is the simplification of housekeeping brought about by the use of the partially prepared viands now in the market. But we would suggest that substitutes, occasionally shown, can never take the place of the real articles.

— A European correspondent informs us that a Russian expedition is now in north-east Siberia for the purpose of bringing back a mammoth which has been discovered there frozen in a perfect condition. The writer adds that he has strong hopes the naturalist in charge of the expedition may discover the eggs of Ross's Rosy Gull (*Rhodostethia rosea*), as yet unknown to oölogists.

— The Bausch & Lomb Optical Co., Rochester, N. Y., recently issued the thirteenth edition of their "Illustrated Catalogue of Microscopes, Objectives, and Accessories." This firm has now made and sold ten thousand microscopes, not including thousands of dissecting microscopes, which means that their instruments are in very wide use in this country, and the firm takes pleasure in stating that a European demand is now growing, showing an appreciation of their work abroad. By contract with the well-known maker, Carl Zeiss of Jena, the Bausch & Lomb Optical Company are made the sole manufacturers, under the patents, of the Zeiss photographic lenses.

— The School of Political Science of the Brooklyn Institute of Arts and Sciences, for which provision has been made by the Department of Political Science of the Institute, and some account of which was published in *Science* for May 20, will be formally opened with a public meeting at Association Hall, on Monday evening Oct. 10. Mr. John A. Taylor, president of the department, and other well-known citizens of Brooklyn, who are interested in the movement, will address the meeting. At the same time the courses of study established by the committee on the school will be announced and described. The committee on the School of Political Science comprises some of the most successful business men in the city, as well as distinguished representatives of the professions and of the prominent educational institutions of Brooklyn, between which and the institute a cordial understanding and co-operation exist. The committee have taken great care in the selection of instructors for the school and the arrangement of the courses of study, and are well satisfied with the results thus far attained. The faculty of the school, so far as selected, consists of Charles H. J. Douglas, Professor of Political Economy, and Lewis G. Janes, Professor of Civil Government. Dr. Janes is well and favorably known in Brooklyn as the president for several years past of that very successful organization, the Brooklyn Ethical Association. He brings to his work in the school maturity, enthusiasm, and thorough scholarship, and will make his courses in civil government both popular and instructive. Professor Douglas, who has been secretary of the Department of Political Science since the resignation of Professor Frank J. Goodnow of Columbia College from that position two years ago, will have charge of the classes in political economy. He is a graduate of Brown University, and has studied at Yale, Johns Hopkins, Michigan, and Columbia, receiving from the last-named institution the degree of Doctor of Philosophy, and an appointment as Seligman Fellow in political science. It is expected that Dr. Douglas's work at the institute will be as successful and popular as it has been at the Brooklyn Boys' High School, in which for several years he has had charge of the work in political science. The matter of raising a permanent fund for the School of Political Science is one that should appeal strongly to those possessed of means and interested in the education of our youth in the duties of citizenship. A guaranty fund has been raised, sufficient to insure the support of the school irrespective of the size of classes for the first year; but a permanent endowment of $50,000 or $100,000 is needed to put the school in the best possible condition to do the work proposed by its projectors.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

ANTARCTIC EXPLORATION.

BY HUGH ROBERT MILL, LIBRARIAN, ROYAL GEOGRAPHICAL SOCIETY.

CONSIDERABLE interest has been awakened by the greater part of the Dundee whaling fleet abandoning the Davis Strait "fishing" and taking their departure for the Antarctic seas. The venture is a purely commercial one, and has been in contemplation for some time, as the northern whaling has in recent years become almost unremunerative. Shortly before the vessels sailed it became known that they might possibly afford some facilities for scientific work, and the Royal Geographical Society (London), the Meteorological Office, and other institutions took steps to obtain successful observations. Additional chronometers and standard compasses were supplied to all the vessels, together with a complete set of the best meteorological instruments. The captains undertook to lay down their track as accurately as possible, and to fix the position and report upon the appearance of any land they might sight in the far south; also to observe the variation of the magnetic needle as frequently and carefully as they could. It is not likely that startling geographical discoveries will be made, although perhaps the coast of Graham's Land may be followed farther south and more accurately mapped. Everything in this department must depend on the discretion of the captains and the caprice of the whales. The vessels will not try to make a high latitude unless it is necessary to do so in order to get a cargo, but the captains will not hesitate to force their way far into the ice if they find it to be necessary, and from their long Arctic experience in ice-navigation it is safe to say that nothing less than an impenetrable barrier will stop them.

It is unnecessary to remind the readers of *Science* that since the expeditions of Wilkes and Ross, fifty years ago, no explorations worthy the name have been made in Antarctic seas. The Challenger, probably the only steamer that has gone so far south, merely crossed the Antarctic circle, and, being unprotected against ice, had immediately to return. Recent oceanographical and meteorological researches have gradually increased the desirability of improved knowledge of high southern latitudes, and representations have been made on several occasions as to the advisability of a properly equipped scientific expedition being sent out by the British Government. While this desirable expedition is deferred, the necessarily fragmentary results of trading voyages may afford most valuable hints,

The four Dundee ships, which sailed on September 6, 7, and 8, are barque-rigged wooden vessels fully protected for ice-work and provided with auxiliary steam. Their tonnage is about 400, but on account of the enormous thickness of their timbers the size externally is nearly that of 600-ton ships. Three of the vessels, the "Balaena," Captain Fairweather; the "Active," Captain Robertson; and the "Diana," Captain Davidson, carry surgeons who were specially selected on account of their scientific tastes and their willingness to utilize all opportunities to the full. Mr. W. S. Bruce, the surgeon of the "Balaena" has a very complete equipment of apparatus for sea-temperature work and for biological collecting. He is accompanied by an Edinburgh artist, Mr. W. G. Burn Murdoch, who goes specially with the object of sketching the scenery of the southern ice. Dr. Donald on the "Active," and Mr. Campbell on the "Diana" are also equipped with appliances for collecting. Each of the ships carries a photographic apparatus.

The scientific results expected on the return of the whalers six or seven months hence are as follows: Full meteorological logs with records of surface sea temperatures and densities, and of temperatures at a few points down to the depth of 150 fathoms; deeper observations would be impracticable without hampering the real business of the cruise. A large collection of small surface organisms will be secured by tow-nets, a mode of collecting for which there will be unlimited opportunities as the vessels slowly follow their boats when engaged in whaling. No dredging can be attempted in deep water, but it is possible that there may be some shore-collecting in southern lands not previously visited. Observations on ocean-currents will be made by the captains in the ordinary course of navigation, but floats will also be launched in high southern latitudes, the recovery of which will be looked for with interest. Special attention will be directed to all phenomena connected with sea-ice, and, in case of any mud or stones being observed embedded in icebergs, an effort will be made to secure specimens in order to get some idea of the geology of the land hidden under the southern ice-cap. A large and representative selection of birds will almost certainly be secured, and some problems as to migration may be elucidated. Samples of sea-water from various depths will be brought back for careful analysis.

From a scientific point of view the expedition will be the more successful the worse it is commercially; for, if whales are not found on the margin of the ice, a very high latitude may be reached during the search for them. In any case the barometric readings are bound to be of the greatest interest, as they will throw light on the remarkable area of permanent low pressure which surrounds the South Pole. And it is impossible that the observations of so many highly trained sailors and enthusiastic naturalists can be barren of results in many departments.

THE ABORIGINAL USE OF BONE IN VERMONT.

BY G. H. PERKINS, UNIVERSITY OF VERMONT.

OBJECTS wrought from bone appear to be quite uncommon throughout the country, unless it be in the neighborhood of shell-heaps. Certainly in the Champlain Valley they are the rarest of archæological finds, and until within a few years none had been found, so far as is known to the writer. At Plattsburgh, on the New York side of the lake, a few pointed implements and barbed spear-points have been found, and are in the fine local collection made by Dr. D. S. Kellogg of that place; but until very recently none had been found on the Vermont side, and they are still exceedingly rare, although, in all, many hundreds of stone implements and ornaments, some of them of very fine workmanship, have been discovered, as well as many fragments of decorated earthenware and a few implements of copper and ornaments of shell.

For many purposes, as awls and the like, bone would seem better suited than stone and much more easily worked; and it is hardly conceivable that bone was not used more commonly than is indicated by our collections. And yet, making all possible allowance for the perishability of bone, we cannot suppose that objects made of this material were ever very abundant; for the other specimens found in some of our localities are not very ancient; and, in more than one instance, entire bones have been found in fair preservation, and there is no reason to think that if bone objects had ever been associated with those of stone they would not now be found with them.

We must then conclude that, for reasons sufficient to themselves, the former occupants of the Champlain Valley did not fashion many of their implements or ornaments from the bones of the animals which they captured, although we must admit that the few specimens found do not fairly represent the entire stock of such objects which were made and used.

After collecting in this region for more than fifteen years without seeing a single specimen of worked bone, the first one made its appearance near an old village-site, while I was digging out some bits of pottery from beneath a pine stump. It was only a tine of a deer's antler, the surface of which had been smoothed, and a rudely cut groove was about the large end, as if to enable the owner to fasten a cord for suspending the object as an

FIG. 1.

ornament. So little-wrought a specimen would attract little attention usually, but it was taken associated with stone implements, from beneath a pine stump, and was our first of its kind, and therefore possessed especial value. It is white and somewhat chalky in appearance; but I do not suppose it to be necessarily of great age, though not very recent. This specimen is about four inches long and three-fourths of an inch in diameter at the larger end. A second and shorter tine was recently found in another locality. The point of this is smoothed, and it may have been used in the decoration of the pottery which was so commonly used, and which was most frequently ornamented with lines, grooves, and the like, made by a more or less blunt point drawn across the unbaked surface of the jars. The most perfectly made and finished point found in Vermont is shown full-size in Fig. 1. It is made from a fragment of a tibia, or some other round bone, and nearly the whole surface,

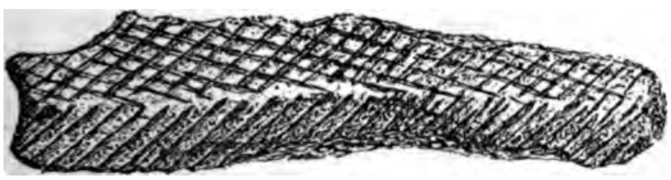

FIG. 2.

except the groove of the medullary canal, is well smoothed, and the pointed end is exceedingly well finished. This specimen was found not far from Burlington, and with it were fragments of bones, a canine of a bear, as well as stone implements. From the simple unornamented objects. such as those just mentioned, to such as that shown in Fig. 2. is a long step, but we have nothing intermediate. The specimen shown in Fig. 2 is, as the figure shows, broken along the upper and lower edge. Whether it originally was made from an entire section of a round bone, or was merely a fragment as we have it, is not readily determined. If fractured since it was ornamented, the breaking is not recent. It may have been a whistle, or tube for some other use.

As to the decoration, a glance at the figure will give a better idea of that than any description. The lines are sharply incised and quite regular, although the tool by which they were made now and then went a little astray, and the whole effect is very neat. The ends are smooth and somewhat bevelled or rounded. The length of this specimen is a little less than three and a half inches, and the greatest width three-fourths of an inch. It was found near Swanton, not far from the Canada border.

Another, and, if genuine Indian work, very interesting specimen is a mask made from a piece of a femur or some thick bone. The face is boldly and not unskilfully carved, the features all of them being strongly marked. It was found buried in the earth, not far from the specimen figured above, near Canada, and may quite possibly be the work of a passing hunter or soldier; and it is also, and perhaps equally, possible that it was carved by one of the St. Francis Indians, who formerly roamed about the region where it was found. It is apparently not very ancient. The face is oval, an inch and three-eighths long, and one and one-eighth wide, and, including the rather prominent nose, five-eighths of an inch thick.

The list here given is certainly very meagre, but it includes all kinds that have been found, and its brevity simply emphasizes the rarity of such objects in Vermont.

ON THE INTROSPECTIVE STUDY OF FEELING.

BY HIRAM M. STANLEY, LAKE FOREST UNIVERSITY, ILL.

OF all the sciences psychology is, perhaps, the most imperfect. If a science is a body of knowledge obtained by special research and accepted by the general *consensus* of specialists, then psychology is so defective as to scarcely merit the name of science. This want of *consensus* is everywhere apparent and must especially impress any one who compares the lack of harmony in manuals of psychology with the practical unanimity in manuals of botany, geology, physics, and other sciences. Even in the most fundamental points there is no agreement, as will be evident in a most summary statement.

It is now something more than a century since the general division of psychic phenomena into intellect, feeling, and will, first came into repute, but still some psychologists of note do not agree to this fundamental classification, but would unite feeling and will in a single order. As to the subdivisions of feeling and will we are confessedly wholly at sea. In intellect it is only on the lower side, sensation and perception, that anything of great scientific value has been accomplished; and even now it cannot be said that the classes of sensation have been marked off with perfect certainty. In the higher range of intellect psychology can do scarcely more than accept some ready-made divisions from common observation and logic. And if so little has been settled in the comparatively simple work of a descriptive classification of the facts of mind we may be assured that still less has been accomplished toward a scientific *consensus* for the laws of mind. Weber's law alone seems to stand on any secure basis of experiment, but its range and meaning are still far from being determined. Even the laws of the association of ideas are still the subjects of endless controversy. Also in method there is manifestly the greatest disagreement. The physiological and introspective schools each magnify their own methods sometimes so far as to discredit all others. Physiological method has won for itself a certain standing, indeed, but just what are its limitations is still far from being settled.

But the grievous lack of generally accepted results is most apparent in the domain of feeling. The discussion of feeling in most manuals is very meagre and unsatisfactory. Professor James's recent treatise, for instance, gives some 900 pages to the Intellect, and about 100 pages each to Feeling and Will. There is little thorough analysis and no perfected inductive classification. We often, indeed, find essays of literary value which appeal to the authority of literature. But to refer to Shakespeare or Goethe as psychological authorities or in illustration or proof of psychological laws is generally a doubtful procedure. The literary and artistic treatment of human nature is quite distinct from the scientific, and literature and art cannot be said to be of much more value for psychology than for physics, chemistry, or biology. To appeal to the Bible or Shakespeare in matters psychological,

is usually as misleading as to consult them for light on geology or botany. Even the fuller treatises on the subject of feeling rarely reach beyond literary method and common observation, being for the most part a collection and arrangement of the results of common sense, accepting common definitions, terms, and classifications. Now, science is always more than common sense and common perception, it is uncommon sense; it is an insight and a prolonged special investigation which penetrates beneath the surface of things and shows them in those inner and deeper relations which are entirely hid from general observation. Common views in psychology are likely to be as untrustworthy as in physics or astronomy, or any other department. Science must, indeed, start with common sense but it does not deserve the name of science till it gets beyond it.

Again, the subject of pleasure, pain, and emotion, is usually discussed with considerable ethical or philosophical bias. The whole subject of feeling has been so naturally associated with ethics and philosophy from the earliest period of Greek thought that a purely colorless scientific treatment is quite difficult. Furthermore, feeling has been too often discussed from an *a priori* point of view, as in the rigid following out of the Herbartian theory of feeling as connected with hindrance or furtherance of representation. Still further, the physical side of emotion has been so emphasized by the physiological school as to distract attention from purely psychological investigation. How far this may lead is seen in Professor James's theory of emotion which makes it the reflex of the so-called expression.

It is obvious, then, on the most cursory review that very little has been accomplished in the pure psychology of feeling. Here is a region almost unexplored, and which, by reason of the elusiveness and obscurity of the phenomena has seemed to some quite unexplorable. Dr. Nahlowsky truly remarks, that feeling is a "strange mysterious world, and the entrance to it is dark as to Hades of old." Is there any way out of this darkness and confusion? If the study of feeling is to become scientific and give assured results, we must, I think, assume that all feeling is a biological function governed by the general laws of life and subject in origin and development to the law of struggle for existence. Assuming this strictly scientific point of view we have to point out some difficulties in the way of the introspective psychology of feeling as compared with other departments of biological science.

We trace directly and with comparative ease any physical organ and function from its simplest to its most complex form; for example, in the circulation of the blood there is clearly observable a connected series from the most elementary to the most specialized heart as developed through the principle of serviceability. In some cases, as in the orohippus, a form in the evolution of the horse, we are able to predict an intermediate organism. Psychology is still far from this deductive stage; we have no analogous series of psychic forms, much less are able to supply, *a priori*, the gaps in a series. The reason for this is mainly the inevitable automorphism of psychological method. In biology we are not driven to understand life solely through analogy with our own life, but in psychology mind in general must be interpreted through the self-observation of the human mind. In biology we see without effort facts and forms of life most diverse from our own; the most strange and primitive types are as readily discernible as the most familiar and advanced, the most simple as the most complex. We study a fish just as readily as a human body, but the fish's mind — if it has any — seems beyond our ken, at least is not susceptible of direct study, but a matter for doubtful inference and speculation. Whether a given action does or does not indicate consciousness, and what kind of consciousness, this is most difficult to determine. Thus we have the most various interpretations, some, as Clifford, even going so far as to make psychic phenomena universal in matter, others, on the other hand, as Descartes, limiting them to man alone.

The difficulty of this subjective method, this reflex investigation, is almost insurmountable. Consciousness must act as both revealer and revealed, must be a light which enlightens itself. A fact of consciousness to be known must not simply exist like a physical fact or object, as a piece of stone, but it must be such that the observing consciousness realizes or re-enacts it. To know the fact we must have the fact, we must *be* what we *know*. Mind is pure activity, we do not see an organ and ask what it is for, what does it do; but we are immediately conscious of consciousness as activity, and not as an objective organ. We must here then reverse the general order and know the activity before we can identify the organ as a physical basis.

By the purely objective vision of the lower sciences we can easily determine a genetic series of forms most remote from our own life, but in psychology, mind can be for us only what mind is in us. The primitive types of psychosis are, no doubt, as remote and foreign from our own as is the primitive type of heart or nervous system from that of man's In the case of heart and nerve we can objectively trace with certainty the successive steps, but in endeavoring to realize by subjective method the evolution of mind we are involved in great doubt and perplexity. How can we understand an insect's feelings? How can we appreciate minds which are without apprehension of object, though there is reason to believe such minds exist? Only to a very limited extent can a trained and sympathetic mind project itself back into some of its immediately antecedent stages. Consciousness, because of its self directive and self-reflective power, is the most elastic of functions, yet it can never attain the power of realizing all its previous stages. Sometimes, however, the mind in perfect quiescence tends to relapse into primitive modes, which may afterward be noted by reflection, but such occasions are comparatively rare. The subjective method means a commonalty of experience which is often impossible to attain. Thus a man may believe there are feelings of maternity; he has observed the expression of nursing mothers, and knows in a general way that here is a peculiar psychosis into which he can never enter, and which is, therefore, beyond his scientific analysis. The psychic life of the child is more akin to his than that of the mother; yet it is only by an incessant cultivation of receptivity and repression of adult propensities that one can ever attain any true inkling of infant experience. There is then, I think, a vast range of psychic life which must forever lie wholly hidden from us either as infinitely below or infinitely above us; there is also an immense realm where we can only doubtfully infer the presence of some form of consciousness without being able to discriminate its quality, or in exceptional cases to know it very partially; and there is but a relatively small sphere where scientific results of any large value may be expected. By reason of its objective method the realm of physical science is practically illimitable, but psychic science is by reason of its subjective method kept forever within narrow boundaries.

We must then take into account the inherent difficulties of the subjective method as applied to the study of feeling and mind in general and yet we must recognize its necessity. No amount of objective physiological research can tell us anything about the real nature of a feeling, or can discover new feelings. Granting that neural processes are at the basis of all feelings as of all mental activities, we can infer nothing from the physiological activity as to the nature of the psychic process. It is only such feelings and elements as we have already discovered and analyzed by introspection that can be correlated with a physical process. Nor can we gain much light even if we suppose — which is granting a good deal in our present state of knowledge — that there exists a general analogy between nerve growth and activity, and mental operations. If relating, i. e., cognition, is established on basis of inter-relation in brain tissue, if every mental connecting means a connecting of brain fibres, we might, indeed, determine the number of thoughts but we could not tell what the thoughts were. So if mental disturbance always means bodily disturbance, we can still tell nothing more about the nature of each emotion than we knew before. We must first know fear, anger, etc., as experiences in consciousness before we can correlate them with corporeal acts.

Is now this necessarily subjective method peculiarly limited as to feeling? Can we know feeling directly as psychic act or only indirectly through accompaniments? Mr. James Ward (*vide.* article on Psychology in the Encyclopædia Britannica, p. 49 cf. p. 71) remarks that feelings cannot be known as objects of direct

reflection, we can only know *of* them by their effects on the chain of presentation. The reason for this is that feeling is not presentation, and "what is not presented cannot be re-presented." "How can that which was not originally a cognition become such by being reproduced?"

It cannot. But do we need to identify the known with knowing, in order that it may be known? Must feeling be made into a cognition to be cognized? It is obvious enough that no feeling can be revived into a re-presentation of itself, but no more can any cognition or any mental activity. Revival or recurrence of consciousness can never constitute consciousness of consciousness which is an order apart. If cognition is only presentation and re-presentation of objects, we can never attain any apprehension of consciousness, any cognition of a cognition or of a feeling or of a volition, for they are all equally in this sense subjective acts. Re presentation at any degree is never by itself sense of re-presentation or knowledge of the presentation.

Of course, the doctrine of relativity applies to introspection as to all cognition, and subject *qua* subject is as unknowable as object *qua* object. We do not know feeling in itself, nor anything else in itself, the subjective like the objective *ding an sich* is beyond our ken. Yet kinds of consciousness are as directly apprehended and discriminated as kinds of things, but the knowing is, as such, distinct from the known even when knowing is known. Here the act knowing is not the act known and is different in value. The object known is not, at least from the purely psychological point of view, ever to be confounded with the knowing, to be incorporated into cognition by virtue of being cognized. Feeling, then, seems to be as directly known by introspection and reflection as any other process. It is not a hypothetical cause brought in by the intellect to explain certain mental phenomena, but it is as distinctly and directly apprehended as cognition or volition.

The distinction between having a feeling and knowing a feeling is a very real one, though common phraseology confuses them. We say of a brave man, he never knew fear; by which we mean he never feared, never experienced fear, and not that be was ignorant of fear. Again, in like manner, we say sometimes of a very healthy person, he never knew what pain was, meaning he never felt pain. These expressions convey a truth in that they emphasize that necessity of experience in the exercise of the subjective method upon which we have already commented, but still they obscure a distinction which must be apparent to scientific analysis. We cannot know feeling except through realization, yet the knowing is not the realization. Being aware of the pain and the feeling pain are distinct acts of consciousness. All feeling, pain and pleasure, is direct consciousness, but knowledge of it is reflex, is consciousness of consciousness. The cognition of the pain as an object, a fact of consciousness, is surely a distinct act from the pain in consciousness, from the fact itself. The pain disturbance is one thing and the introspective act by which it is cognized quite another.

These two acts are not always associated though they are commonly regarded as inseparable. It is a common postulate that if you have a pain you will know it, or notice it. If we feel pained we will always know it. This seemingly true statement comes of a confounding of terms. If I have a pain I must, indeed, be aware of it, know it, in the sense that it must be in consciousness; but this makes, aware of pain, and knowing pain, such very general phrases as to equal experience of pain or having pain. But there is no knowledge in pain itself, nor pain in the knowing act *per se*. The knowing the pain must be different from the pain itself, and is not always a necessary sequent. We may experience pain without cognizing it as such. When drowsy in bed I may feel pain of my foot being "asleep," but not know it as a mental fact. We may believe, indeed, that pain often rises and subsides in consciousness without our being cognizant of it, but, of course, in the nature of the case there is no direct proof, for proof implies cognizance of fact. Pain as mental fact, an object for consciousness, not an experience in consciousness, is what is properly meant by knowing pain. Consciousness-of-pain as knowledge of it is not always involved by pain-in-consciousness as experience of it. Consciousness of pain by its double meaning as cognizance of pain and experience of pain leads easily to obscurity of thought upon this subject. But experience does not, if we may trust the general law of evolution from simple to complex, at the first contain consciousness of experience. This latter element is but gradually built up into experience, though in the end they are so permanently united in developed ego life that it is difficult to perceive their distinctness and independence.

We conclude then that while not all feelings, that is, pains and pleasures, are discovered simply by virtue of being acts of consciousness, and that not all consciousness is apperceptive of itself, yet in general feelings are known as such, and there is nothing in their nature to make them only indirectly observable by consciousness. The direct subjective method certainly presents great difficulties especially in evolutionary psychology, but still it must be accounted the only method for feeling as for all regions of psychic life.[1]

[1] For a special carrying out of the principles herein advocated see the writer's article on Primitive Consciousness in the Philosophical Review, July, 1892.

REMARKS ON AMERICAN LICHENOLOGY. — II.

BY W. W. CALKINS.

IN the *Lichens* the geographical distribution of species is quite as interesting as in phænogamia. I shall in this paper confine myself to observations and collections made in the sub-tropical section of our country. The tracing of species to their native habitats, and thence following them over often wide areas of dispersion until arrested in their progress by conditions unsuitable to their growth, is an important work for the botanist and for science. Florida — more especially its southern extremity — offers an attractive field and unusual advantages. One may draw a line east and west across the State in about latitude 25°, and below this will be found new conditions of soil, climate, and productions. A new and peculiar flora exuberant in growth will come into view. With both shores laved by the warm waters of the Gulf Stream, that "river in the ocean," also the Bahamas and Cuba less than one hundred miles distant, the reasons for the similarity of life to that of the Antillean system are plain. One has only to wander along these sunny shores and gather by bushels the proofs of what I say in such species as *Guilandina*, *Bonduc*, *Mucuna*, *Urens*, etc., that have been brought by the sea from other climes.

Then tropical Algæ claim the attention. Approximately the line I have mentioned represents two vast and dissimilar floras, each overstepping somewhat the territory of the other, but retaining the mastery in their respective fields. Here northern forms become intruders, southern less common. Many arborescent ones dwindle to shrubs. *Per contra*, further north the same law obtains. Thus hath nature set her limits. Standing on this borderland, and amazed at the change in the higher orders, I wished to know about the lower. In this field not much has been done. Our knowledge of the lichens has been until recently limited. It is my purpose to extend this knowledge somewhat, believing that it may be useful.

Most of the species described by Nylander and Túckerman, as from Cuba and some from further south, will be found in Florida. The great order *Graphidacei*, one of the most perplexing, abounds in new species, and I am satisfied that further research will add to the number in this and other orders. I now make nearly four hundred and fifty species, which is indeed a great number for one section when we remember that only a few years ago Willey estimated that ultimately one thousand might be found on the entire continent. The final total in Florida will exceed five hundred; and I allow for some reductions which must follow their final resolution, for, as hinted in a former paper, this is more important than new species, especially if, as asserted, "species only exist in text-books," — a proposition from which I dissent.

The following observations will only embrace a few of the rarer and little-known forms collected by me, and some others of my discovery described as new to science: *Gyalecta cubana* Nyl. On calciferous rocks, Keys of Florida, and on the main land Also in Cuba. Identified by Dr. Nylander. *Chiodecton sphærale* Nyl. A rare tropical form first found by me near Jacksonville — and

south — on *Nyssa aquatica*. *Trypethelium sprengelii* Nyl. On various barks of trees, Key West to Jacksonville. *Opegrapha diapharoides* Nyl. On oaks from Jacksonville south. The great genus *Biatora* has many species. Of these *B. carneo-albens* Nyl. and *B. Floridensis* Nyl., found by me on *Carpinus*, are new, and of tropical derivation. Two other great genera, *Arthonia* and *Graphis*, teem with new species and rare forms. These find here their greatest expression, and the latter is reduced north of Florida to a very few species.

CURRENT NOTES ON ANTHROPOLOGY.—XVI.

[*Edited by D. G. Brinton, M.D., LL.D.*]

Linguistics as a Physical Science.

WHEN one surveys the works on linguistics which have appeared in the last few years, especially such as deal with the principles of changes in languages, it is easy to classify their writers into two groups, the one preferring to explain such changes by processes of mind, the other by purely physical conditions. This distinction goes back to that which would regard linguistics as a branch of natural history, and its laws no other than purely physical ones; or, on the other hand, that which claims the changes in language come chiefly through principles of psychology, logic, and metaphysics.

Some have aimed at a compromise by saying that linguistics is in its contents a mental science, but in its methods a natural science. Professor H. Schuchardt remarks, in a late number of the *Literaturblatt für Ger. und Roman. Philologie*, that it would be just as correct to reverse this statement, or to take the position that it is half a natural and half a historical science; provided that in the latter case we understand the two members of the proposition to be successive and not contradictory, the natural element passing into the historical. "Because," he concludes, with a remarkable expression of his position, "I believe in the unity of the science, and hold that there is no greater difference between biology and linguistics than between biology and chemistry."

Gerland's Atlas of Ethnography.

I have had at hand all summer the "Atlas der Völkerkunde," by Dr. Georg Gerland, professor at the University of Strasburg (1 Vol., Gotha, Justus Perthes, 1892), and can speak of it now after that much use. It is composed of fifteen folio maps, and, as it is, I believe, the first complete ethnographic atlas ever published, it will not be out of place to give its contents. They are: I., Distribution of skin and hair; II., Density of population; III., Distribution of religions; IV., Distribution of diseases; V., Clothing, food, dwelling, and occupations; VI., Location of peoples in 1500 and 1880; VII., Europe in 1880; VIII., Asia in 1880; IX., South-east Asia; X., Oceanica; XI., Africa; XII., Aboriginal America; XIII., America in 1880; XIV., Linguistic map; XV., Europe about 100–150 after Christ.

The first impression one has in examining the Atlas — and with me it is one that remains — is that entirely too much is attempted for a work of the size. The charts are necessarily on too small a scale and omit too much to be satisfactory for the special student; and what student is not special nowadays? The list of subjects above given will be enough to convince the reader that detail cannot be attempted in most of the charts. Turning to the map of the American aborigines, there is an evident lack of classification. For instance, what does "Peruvian peoples" mean? It is neither a linguistic nor physical group, and scarcely a political one. All tribes of Chili, Patagonia, the Pampas, and Tierra del Fuego are included under one rubric, and called "Chilians or Patagonians." Such classifications are worse than worthless, because they are misleading; and these by no means stand alone.

But it would be unfair to measure this atlas by its treatment of America, which, as usual in all works of the kind, suffers the most. In general, the Atlas is one of immense labor and of corresponding value. It ought to be in the library of every geographer and student of ethnography.

To Deduce the Stature from the Measurements of the Long Bones.

This is a problem which has occupied anatomists considerably, without leading to as uniform conclusions as one could wish. There are important ethnic variations in the length of the long bones of both extremities, as is well known, and others run in families, or are peculiar to the individual. Scott says of Rob Roy, that standing straight he could tie his garter below the knee. Such a statement makes an osteologist wish for his bones! Long fore-arms are ethnically a sign of an inferior race. Hence all proportions must to some extent be modified by considerations of race.

A general formula has lately been advanced by M. Etienne Rollet, which seems to me, after comparing it with the measurements in Topinard, Schmidt, and others, the most convenient I have seen, and sufficiently accurate. The list of coefficients is stated as follows in the *Revue Scientifique* for August: —

	Femur.	Tibia.	Fibula.	Humerus.	Radius.	Ulna.
Min.	3.66	4.53	4.58	5 06	6.86	6.41
Max.	3.71	4 61	4.66	5.22	7.16	6.66

It is enough to multiply the length of the long bone named by the coefficient given above, to obtain the height; and by taking the average of a number of such measurements we reach a figure accurate enough for the height of either sex. I say accurate enough, because there is no use in being excessively precise on this question. It is well known that there is quite a difference in our stature when we rise in the morning, and when we go to bed after a hard-day's walk.

The Birch-Tree as an Ethnic Landmark.

In a late number of the *Globus*, Dr. Krause of Kiel reviews the question of the origin of the Aryan nations as shown by the word for *birch*. The terms for birch and willow are the only two tree-names which are common, or practically so, to all tongues of the Indo-Germanic group. The ancestors of all must have come, therefore, from some locality where these trees were indigenous, and where they were of importance in the economics of the ancestral horde. The birch meant is the *Betula alba*, or white birch, and its uses in primitive conditions are numerous and familiar, as are also those of willow twigs.

All this is well known, and therefore not new. But the conclusion which has been drawn from it in favor of the derivation of the Indo-Germanic peoples from the habitat of the birch in the north of Europe is seen to be unsubstantiated, when we learn that the *Betula alba* flourishes all through Siberia, from the highlands of Afghanistan to Japan, and that two closely allied species, the *acuminata* and the *bhojpattra*, are found in various parts of the Himalayas, and in the mountains of central Asia. In Iran and on the plains of Turkestan none of these trees occurs. It would seem, therefore, that this single verbal identity does not carry us far.

To show how close the correspondences of the names of the tree are, I will quote some: English, *birch*; High German, *birke*; Hindustanee, *burj*; Sanscrit, *bhurja*; Italian, *bedoja*; Latin, *betula*; Irish, *beithe*, etc. It is a marvel to see how through unnumbered generations and over so many thousands of miles the word has retained its physiognomy.

Slavic Archæology.

Dr. Lubor Niederle is privat-docent in the branches of anthropology and pre-historic archæology at the University of Prague. That city is quite decidedly Check or Slavic, and much of the instruction is carried on in the Bohemian dialect of that tongue. In it, also, Dr. Niederle publishes his works, the last of which treats of pre-historic man in Europe with especial reference to the archæology of the Slavic countries. The title is "Lidstvo v Době Prědhistorické." It is to be hoped that of a portion of it he will prepare an abstract in French or German, as the Bohemian is a dialect with which most scientists are not familiar. The importance of such an abstract is the greater because many Slavic observers, especially local archæologists, have in late years taken

to publishing their articles exclusively in journals in their own tongue, and it thus becomes very difficult to follow their researches.

All who have interested themselves in proto-historic European ethnology are aware of the obscurity that reigns over the relationship of the early Slavonic tribes; it is only one degree better than the quite impenetrable fog surrounding the Celts. Their craniology is wholly conflicting; and to-day, if an anthropologist were to speak of "the Slavonic type," I should not have any idea whether he meant a blonde or a brunette, a long skull or a broad skull, a short or a lofty stature, narrow or wide eyes. The Slavonic languages, however, are permanent testimonies to a former linguistic unity.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

A Gynandrous Flower-Head.

A GYNANDROUS flower-head of the Iceland poppy is now in my possession. The ordinary seed-case is perfectly formed, including the stigmas. Round it are what should be the stamens; but twenty or more of these are thickened gradually upwards from the base of the filament, ending in a golf-club-like head. On the outer side some of these have anthers more or less completely developed; but in all the inner side is concave, containing three to fifteen or more ovules attached round the edge. The sketch will assist in explaining this extraordinary botanical monstrosity.

POPPY MONSTROSITY.

J. EDMUND CLARK.

York, England.

Is There a Sense of Direction?

A RECENT article in *Science* by the facile pen of Dr. Hall on the "Sense of Direction" concedes the absence of such a faculty in civilized man at least, and possibly also in the semi-civilized as well; but he believes beyond cavil that the lower animals do have this gift denied to man.

That which appears to be a "sense of direction" in animals can, I believe, in every case be explained by the power of observation and memory, or by accident.

Men and animals alike, under given circumstances, are compelled to both observe and remember, until the one becomes as easily and unconsciously done as the other, and, for all the purposes of this article, the memory to have existence must be established upon facts learned by observation. It is very well known that an unguided horse returning to familiar haunts will do so over the same route by which he left them, rather than in a direct line by sense of direction. The very few instances recorded of animals returning from incredible distances, over which they had been carried, can doubtless be explained by their having been able to observe the route travelled, or by accident, or by the fact of their being unauthenticated nursery tales, with the possible exception of the homing pigeon, birds of wonderful flight and sight, many of which never reach home, while the arrival of many more is unaccountably delayed. Their ability to return is, I believe, no more fully explained than is the no less wonderful one of the wild water-fowls, which are taught to fly north in spring and south in autumn, or why they fly low one season and high the next, possibly in both instances determined by the character of the upper air-currents.

The case, instanced by the doctor, of the Mexican sheep-herder's ability to minutely describe travellers who had passed days previously might very aptly be used to illustrate the similarity of the mental processes necessary alike in man and animals in the matter of direction. The Mexican herder saw the travellers, to him an unusual sight, his mental perception, unoccupied by impressions other than those caused by these travellers, accurately photographed on his mind, as upon the sensitive plate of the camera, every feature of the outfit. In the case of the man, he perceived as well as saw, and could again reproduce the picture, call it up for the inspection of the mind's eye at will; but in the case of the brute that which has been seen has passed beyond possibility of recall, except by the stimulus of the same impressions repeated, when the impression is recognized as familiar. This is brute memory, possible only as a result of having seen or felt, and capable of being reproduced only by the same external agencies, and their so-called "sense of direction" is rather the faculty of recognizing at sight as familiar that which has already been seen.

If the sense of direction be inherent in animals, we would naturally inquire why it is not exhibited before they have reached mature age and been taught by experience, for it is a matter of common observation with those familiar with domestic animals that the stable-reared animal of whatever species is utterly lacking in anything bearing the faintest semblance to a sense of direction; and it is a fact within the common knowledge of most farmers' boys that cats, foragers by instinct and practice, may be carried a very few miles in a sack and never return, and that the barn-yard cock will not return from a distance of one hundred rods, although mercilessly maltreated by his new associates, for his sense of direction is determined by sight only.

All admit that many animals can and do return to their homes, but the explanation of their ability to do so need not be sought and developed by an intricate process of reasoning, if it is, as we believe, necessary that the animal first traverse the road before it can with certainty return. And in conclusion it is sufficient for me to say that, whatever instincts animals may have in this direction, man has the same, with the additional faculty of reason. In both, observation and memory can be highly cultivated, in the animal by necessity alone, and in both by experience only.

Pueblo, Colorado. H. WORK.

Laboratory Teaching.

A RECENT number of *Science* contained a note by Professor William P. Mason referring to a statement of mine concerning the early years of laboratory teaching in chemistry. I need not state that I had no intention of withholding credit from any of the pioneers in the development of scientific education, especially from such institutions as the Rensselaer Polytechnic Institute, which, as everyone knows, from the first has been in the foremost rank. I had in mind the course of laboratory instruction in general chemistry which was established for the training of large classes at the Massachusetts Institute of Technology by Professors Eliot and Storer. This method of instruction, adapted to later advances in knowledge and to the needs of individual laboratories, is now in very general use in teaching elementary chemistry.

CHARLES F. MABERY.

Animal Phosphorescence.

ALL sorts of theories have been advanced to explain generally the real use of these luminous emanations. Some have supposed that the light is intended as an effective aid to the night birds that feed upon this gorgeous fare. But that would certainly be a left-handed provision of nature, quite out of her usually kindly protection. Others, again, guess that the firefly's flash-light is a device to assist him in the search of his own prey. With none of these theories, however, is science fully satisfied, and in the

judgment of the most prudent naturalists the real use of the luminosity of these insects is still utterly unknown.

Can any of the readers of *Science* give me "a great light" on the subject in dispute? CHARLES NIEDLINGER.

New York, 5 East 16th St., Sept. 26.

BOOK-REVIEWS.

An Account of the Principal Facts and Theories Relating to the Colors and Markings of Animals. By FRANK E. BEDDARD, M.A. New York, Macmillan & Co. 8°. $3.50.

THERE is significance in the number of recent works involving a discussion of questions of biological philosophy and a presentation of fundamental principles to intelligent non-scientific thinkers. Starting with Darwin's "Origin of Species," a steadily increasing volume of this kind of literature has been produced to supply an intellectual demand, in itself a grateful proof of the re-adjustment and betterment of the relations between scientists and other thinkers.

Among these newly developed lines of thought, none is more interesting than the significance of coloration in the organic world; and none deals with a subject more intrinsically beautiful. The work under review is an attractive book on an attractive subject. The press-work is good, the type clean and sufficiently large. The four colored plates are a feature which will be much appreciated, while the wood-cuts are well selected and well executed, with the exception of the illustration of the sloth, which is little short of execrable.

The classification of colors according to their supposed purpose is much less intricate than that adopted by Poulton, and not very unlike that of Wallace. A compromise between Poulton and Beddard would have its advantages. Contrary to the promise of the author in the introductory chapter, he has used insects almost, if not quite, as much as Poulton in the presentation of his subject. The author says that his book "contains nothing novel," but we think that he is over modest in this, for his excellent series of experiments for the purpose of determining the palatability of various animals is both new and very much to the point.

In the introductory chapter the origin of animal coloration is explained, and an indication of the anti-Darwinian trend of the work is furnished by a denial of the fact that coloration is always in harmony with the mode of life of the animal, a question which might still be left *sub judice*. Albinism is considered an individual variation, although there is much to indicate that it is a physiological weakness or dermal disease. Although Mr. Beddard does not touch upon the transmission of acquired characters, perhaps thereby showing his wisdom, he is evidently intensely Lamarckian in his beliefs. A comparison between Wallace's "Darwinism" and Beddard's "Coloration of Animals" would be instructive perhaps, but sorely perplexing to the general student, who cares more for ascertaining the truth than being *au fait* in theories. Natural selection is apotheosized by the former, while no author is more persistent in his attempts to minimize the effects of natural selection than the latter. Here again middle ground would seem more safe.

Our author concludes that "the brilliant and varied coloration of deep-sea animals is totally devoid of meaning," a conclusion that will doubtless meet with considerable opposition.

Chapter II., on coloration as affected by environment, is a thoroughly Lamarckian chapter with many significant facts. The nature and quantity of food is held to materially affect coloration. Moisture deepens colors, while a dry climate lightens them. The white of Arctic animals, it is maintained, is due to environment, although this proposition can hardly be said to be substantiated in a satisfactory manner.

In Chapter III., on protective coloration, this well-worn but never tiresome subject is illustrated by a large number of examples in much the usual way. The author is surprised at the small number of green animals frequenting trees. We are inclined to think the number much greater than he admits. For instance, a

Publications Received at Editor's Office.

BAILEY, L. H. The Horticulturist's Rule-Book. New York, Rural Pub. Co. 12°. 221 p.

JOHNSON, WILLIAM W. The Theory of Errors and Method of Least Squares. New York, John Wiley & Sons. 12°. 162 p. $1.50.

MACCORD, CHARLES W. Mechanical Drawing. New York, John Wiley & Sons. 4°. 100 p. $4.

MERRIMAN, MANSFIELD. A Text-Book on the Method of Least Squares. 6th ed. New York, John Wiley & Sons. 8°. 206 p. $2.

MERRIMAN, MANSFIELD. An Introduction to Geodetic Surveying. Part 1. The Figure of the Earth. New York, John Wiley & Sons. 8°. 170 p. $2.

MILNE, WILLIAM J. Standard Arithmetic. New York, American Book Co. 12°. 428 p. 65 cts.

POOR, HENRY V. The Tariff. New York, H. V. & H. W. Poor. 8°. Paper 121 p.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale or Exchange.—The subscriber would like to receive cash offers, or an offer in exchange for the earlier volumes of Poggendorf's Annalen and the later volumes of Silliman's Journal, upon the following list: Chenu.—Manuel de Conchyliologiè. 2 vols. Nearly 5,000 figures, some hand-colored Paper. Paris, 1859. Edwards.—Butterflies of N. A. 2 vols. Plates hand-colored. Vol. I., half calf Vol. II. in parts. Leyman, Agassiz, Hagen.—Ills. Cat. Mus. Comp. Zoel. at Harvard. No. I. Ophiuridae. No. II., Acalephae. No. III., Astacidae. All bound in one volume. American Naturalist. Vols. I.-VII. Cloth. Silliman's Am. Jour. of Science and Arts. Third Series. Vols. I.-X. Cloth. Binney.—Terrestrial Mollusks of N. A. Colored plates. 4 vols. Stretch.—Zygaenidae and Bombycidae of N. A. Colored plates. Also a considerable library of monographs, reports, and scientific books, and a large number of duplicates of fossils, minerals and shells. E. A. STRONG, Ypsilanti, Mich., Sept., 1892.

Exchange.—I have the finest shells of Anodonta corpulenta, C'p'r, and Suborbiculata, Say, in the world. Will exchange for fresh water, land, and marine shells, in large or small quantities. Have also for exchange 50 varieties of fresh water and land shells from Spoon River, Ill. DR. W. S. STRODE, Lewistown, Ill.

To exchange for books on birds or insects, or for back volumes of American Naturalist: Ecker's "Anatomy of the Frog," Packard's "Guide," Guyot's "The Earth and Man," Rockhill's, "The Land of the Lamas," Parker's "Biology," Shoemaker's "Heredity, Health and Personal Beauty," Dexter's "The Kingdoms of Nature," all new. M. J. ELROD, Ill. Wes. Univ., Bloomington, Ill.

For Sale.—About 1087 volumes of the private library of Dr. Nicolas León, formerly director of the Museum at Morelia, embracing publications of special value for Mexicologists, like those of Bishop Zumárraga (16th century), of Siguenza y Gongora, of Aleman, etc., the Missal of Spinoza, all very scarce; manuscripts on the history of Michoacán and other Mexican States, on the Tarasco (the Indian language of Michoacán) and several works, of which the only copy known to exist is in this collection. Parties interested in the sale please address DR. NIC. LEÓN, Portal de Matamoras, Morelia, Mexico.

Wants.

METALLURGICAL CHEMIST will give instruction in the metallurgy and chemical analysis of iron and steel. Complete or special courses applying to the manufacture of pig irons and steels, as well as to their uses. Address "METALLURGIST," care SCIENCE.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems, fossils, shells, archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Hortter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.

WANTED.—A position as zoological artist in connection with a scientific expedition, institution or individual investigations. Experienced in microscopic and all scientific work. References given if desired. Address J. HENRY BLAKE, 7 Prentiss Place, N. Cambridge, Mass.

CHEMIST AND ENGINEER, graduate German Polytechnic, Organic and Analytical, desires a position in laboratory or chemical works. Address 213½ E. 7th Street, New York, care Levy.

A MAN, 36 years old, of extensive experience, having the degrees of A.M. and Ph.D., desires a first-class opening as a teacher of Zoölogy and kindred studies in a college or university. Can furnish numerous testimonials or references as to success and skill in most modern laboratory methods. Address E. W. D., Md. Agr. College, College Park, Md.

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

A YOUNG MAN, with a thorough training in Analytical Chemistry (including analysis of minerals, food, water, etc.), and holding a diploma of the School of Practical Science, of Toronto, and good testimonials, desires a position as Analytical Chemist or as assistant to such. Address to WM. LAWSON, 16 Washington Ave., Toronto, Ontario.

vast multitude of birds are green or olivaceous, at least dorsally. On the other hand, tree-frequenting animals, perhaps a majority of them, are better protected by a color-resemblance to *bark* than to leaves, and they are certainly so protected. The author combats here, as elsewhere, the exclusive or even general agency of natural selection. He confesses that "at every step, in fact, in the study of animal coloration we are met with closed doors, which can only be unlocked by keys furnished by an intimate chemical and physiological knowledge, such as we do not at present possess."

In Chapter IV., on warning coloration, we find the most valuable original feature of the work — the numerous experiments with the palatability of animals, especially insects generally supposed to illustrate warning coloration. These experiments, although furnishing somewhat contradictory evidence, are in the main a valuable confirmation of previous ideas. Dr. Eisig's theory of warning colors is advocated. He thinks that "the brilliant colors have caused the inedibility of the species, rather than that the inedibility has necessitated the production of bright colors as an advertisement," a somewhat startling if not revolutionary idea.

Chapter V. is on protective mimicry. This ever-delightful theme is well handled, although we can hardly repress an instinctive shudder at the iconoclasm which seeks to tear down the exquisite structure so beautifully wrought by Bates, Wallace, Belt, and others, and we hope to be forgiven for expressing a perhaps unscientific but deep-seated aversion to this attempted destructive criticism of the conclusions of those whose knowledge was gained in the woods and fields rather than in the laboratory or dissecting-room.

Chapter VI. treats of sexual selection; but lack of space forbids more than a mention of this chapter, except to enter a protest against the idea that birds do not possess an exalted æsthetic sense. Here again the field-naturalist will be apt to agree with Poulton, who, after presenting a large array of facts, says: "Such facts point toward the existence of a widespread æsthetic sense in the higher animals."

The book as a whole is a valuable contribution to the literature of an intensely interesting subject, and will doubtless be read with pleasure and profit by thousands who do not claim to be scientists. C. C. NUTTING.

State University, Iowa City, Iowa.

Handbook of School Gymnastics of the Swedish System. By BARON NILS POSSE. Boston, Lee & Shepard.

THE merit of the Swedish system consists in the effort to develop in a scientific and systematic manner all the parts of the body. It is not an attempt to make a derrick of the human body by the excessive development of a few lifting muscles, nor does it aim at drills which make an attractive show by the simultaneous movements of identical parts of the body. It discards the old rhythmical and automatic movements as being of but little value. The fundamental principles and advice which form the introductory portion of this little handbook give this definition: "The aim of educational gymnastics is to develop the body into a harmonious whole under the perfect control of the will. It is not to produce great bulk of muscle, but to cause that already present to respond readily to volition, to improve the functional activity of the body, and to counteract and correct tendencies to abnormal development, especially those resulting from 'the artificial life of civilization.' . . . Movements are chosen for physical and physiological effects, local or general, so that only those exercises are used whose effects are needed, and those are excluded whose effects are doubtful or pernicious."

Attention in this country was first called to the Swedish gymnastics by the introduction of the Swedish movement-cure. Though we derive this massage treatment from Sweden, the Japanese have practised a similar method for centuries, utilizing blind people as masseurs.

This handbook will be of great assistance to those who have studied the system.

SCIENCE

NEW YORK, OCTOBER 14, 1892.

ON THE ABSENCE OF COW'S-MILK FROM JAPAN; ITS BENEFICIAL CONSEQUENCES.[1]

BY ALBERT S. ASHMEAD, M.D., NEW YORK.

ONE of the most striking features of that most curious of countries, Japan, is the singular scarcity of domestic animals. There you will never find the fields dotted with oxen or horses drawing the plough; for the Japanese are hardly acquainted with that time-honored tool and symbol of agriculture. Even to serve under the saddle does not come natural somehow to the Japanese horse; "a grudging, ungenerous animal, trying to human patience, with three movements (not by any mans to be confounded with paces), a drag, a roll, and a scramble."[2] Horses and cows are only seen in cities, and on the roads as pack-animals; there are no pastures sweet. Silence is here really a striking magnificent feature of the *rus beatum*. The cone-shaped mystic Fusiyama rises, dimly seen, in the midst of an awful quietness. No lowing herds wind o'er the lea; the barn-yard fowl's is almost a voice *clamantis in deserto*. He reminds the farmer, but only in the morning, that, even under these stagnant circumstances, time flies. Here and there, however, a dog howls; that is all.

The animal life of the land is set apart, concentrated, and taken care of, as in a kind of common preserve, a general park or reservation, in the interior of the land; where it browses and prances and bellows and reproduces itself, contaminating as little as possible that high type of eastern humanity which is now making ready for the baptism of western civilization.

But let me say, in passing, that what the European in Japanese fields misses, I believe, more than anything else, is

"The music of those silver bells,
Falling at intervals upon the ear,
With cadence sweet."

I intend here only to speak of one of the consequences of this quaint absence of animal features, of something not poetical at all, but practical in the highest degree. The cow, in Japan, is not wanted for her milk; otherwise she would lift her voice more boldly in the landscape. Milk, being an animal product, falls under the general condemnation which excludes everything that has pertained to a living body from the alimentation of man. Now, it is true this latter rule has a strange exception, for the animals of the chase are eaten. Let us not shrug our shoulders at the apparent inconsistency; the Oriental mind understands itself. Thus it happens that, as Japan may not use cow's milk, the Japanese mothers are compelled by stress of circumstance to suckle their babes themselves; and these delicate dwarfs have become the most perfect, the most successful *Almæ Matres* of the world.

Artificial lactation is altogether unknown. The children are suckled until the sixth year, and you may hear them ask for the breast in a language as correct as that of adults. But it must be said that the mother's milk is not the only food of the little Japanese. River fish enter for a large part into their diet; after the first year some other elements of general alimentation are added to their bill of fare. But the mother's milk always remains the *plat de résistance*.

Nature and society have endowed this notable mother with some great and peculiar advantages. Here menstruation returns only a year and a half after birth. Moreover, rules dating back to time out of mind insure the young mother a long time of especial attention on the part of the husband and her whole household. The existence of the concubinate is also, strange as it may appear, a considerable relief to the Japanese matrons. All that must tell favorably on the health of the children. Even the infantile minds find themselves in a wholesome, pleasant medium. Nowhere are children so constantly, so lovingly taken care of. Japan, it has been said, is the very paradise of childhood. Nowhere are the adults so well qualified to enter into the nascent ideas of the infant, to play with him; for the nature of the Japanese contains an extraordinary proportion of simplicity and childishness.

The principal food of the mothers, besides the everlasting rice, is fish, shells, sea-weeds, and other products of the sea. No wine or beer enters into the diet of a lactating woman. The great reward which Japan reaps from this meritorious care of motherhood and childhood is the absence of rachitism. All observers have referred to the fact, and to the absence of rachitic pelves, which is the consequence of it; hardly any difficult confinement, and a very small percentage of deaths in child-birth. Now, I think I am not wrong in affirming that the chief and central source of these great sanitary blessings is the absence of cow's-milk.

It is a remarkable fact that Japan, which, according to Dr. Brush,[3] ought to be exempt from tuberculosis, is very far from being so. It is probably well known to you, that, according to this observer, tuberculosis passes from the cattle into the human organism. In Japan, this disease exists mainly in the upper classes where, evidently cow's milk has nothing to do with it, and, where it is easily explained by a systematic custom of close inter-marriage, a system of, according to our ideas, incestuous inbreeding, which has endured for many centuries; this is the same process by which the disease is developed in cattle, according to Dr. Brush. It seems, therefore, that there is no necessity of transmission, and that the human organism worked upon by the same causes will show the same effects. Strange to say, the mountaineers, who have the most intimate relation with the isolated Japanese cattle, on their breeding ground, are practically free from tuberculosis. There is also an historic fact which goes much against Dr. Brush's theory; the cattle were introduced into Japan, from China, in the third century, and tuberculosis is known to have existed there in that same high-bred class from times immemorial. The aristocratic disease, tuberculosis, was certainly communicated to the common people through a very extensive concubinate; and I am equally convinced that it was the milk of the mothers that preserved the lower orders from destruction.

Thus it would appear that the absence of cow's milk, though not a blessing in the sense of Dr. Brush, has had in another way an exceedingly beneficial influence on the general health of the race.

Racial immunities, or the natural resistance of a race to certain diseases, are at least partly transmitted by the mother's milk. It is thus, as I said, that this race is free from rachitism. And there is another privilege of the same kind transmitted through the milk to the suckling. The iodized sea-foods, more especially sea-weeds and the fats and oils of fishes, which have for so many centuries formed a considerable proportion of the

[1] Read in the Section of Diseases of Children, at the forty-third annual meeting of the American Medical Association, held at Detroit, Mich., June, 1892.

[2] Miss Bird, Unbeaten Tracks in Japan.

[3] See "The Relationship Existing between Human and Bovine Tuberculosis," by E. F. Brush, M.D., Mount Vernon, N. Y. Read before the New York Academy of Medicine April 18, 1889 (*N. Y. Med. Jour.*, June 15, 1889). Also "On the Coincident Geographical Distribution of Tuberculosis and Dairy Cattle," by E. F. Brush, M.D. Read before the Medical Society of the State of New York at its eighty-fourth annual meeting (*N. Y. Med. Jour.*, March 8, 1890). Also "Causanguineous Breeding in its Relations to Scrofula and Tuberculosis," by E. F. Brush, M.D. Read before the Society of Medical Jurisprudence and State Medicine, March 10, 1890 (*N. Y. Med. Jour.*, June 28, 1890).

diet of nursing mothers, have without doubt helped to build up the racial resistance to their national inheritanee, syphilis and tuberculosis.

In the case of tuberculosis this resistance is so efficient that even the child of a tuberculous mother, fed on what might be supposed to be tuberculous milk until the sixth year, in the majority of cases remains unaffected. Now, if a tuberculous cow's milk transmits the disease to the human organism, why should not this tuberculous mother's milk transmit it? Even we do not object to the suckling done by our own tuberculous women, which indeed extends generally over but one year, yet their offspring, for the most part, are unaffected by the disease, at least in childhood; now it is more than likely that, if there were a contagion through milk, its effects would be apparent in the children. All these benefits would, of course, be cut off by the substitution of a foreign element to the natural means of transmission.

While I was in Japan, I conceived an idea quite satisfactory, at least to my own mind, of the manner in which the iodized food renders its great service to the Japanese race. It is generally supposed that the contagion of tuberculosis is communicated by the inhalation of particles of dried sputum disseminated in the air. It is my firm conviction that this is not so. I believe that these germs of disease are swallowed with the saliva, and alter the nutrition through the chyle and mesenteric glands. In an organism fed directly or indirectly by iodized substances, the poison meets and is neutralized by its own antidote. The Japanese mother, as by an instinct, never kisses her child on the lips. Indeed, the whole institution of kissing (except in the sexual act) is practically unknown in Japan. It is even formally condemned because the Japanese know that the kiss is the carrier of tuberculosis and syphilis. I have no doubt but that the caresses of the sick have added enormously to our own statistics of tuberculosis, and have caused much of the mischief which Dr. Brush would attribute to cow's milk.

I don't know whether the following has struck any other observer, or if I am the first to call attention to it. There is another, an occult and insidious danger which Japan escapes by letting cow's milk alone. If they drank it as we do, it is very probable that they would drink it as we do, *nolentes volentes*, mixed with a nobler fluid. Now, thanks to the rice plantations, the water of Japan is by no means the best of things; it is even the worst, for it is pregnant with typhoid germs, being continually polluted with human excrements and swarming with the brood of the distoma. Total abstinence from cold water, an inverted teetotalism, has been the salvation of Japan. Water is only drunk boiled with tea; the boiling kills the typhoid germs and the eggs of the distoma.

THE ETRUSCAN RITUAL BOOK [1]

BY DANIEL G. BRINTON, M.D., LL D.

THE discovery by Professor J. Krall of the fragments of an Etruscan book, written in the time of the Ptolomies, and preserved in the swathings of an Egyptian mummy, is an epochal event in archæology and cannot fail to excite the liveliest interest in learned circles. It has just been issued by the Vienna Academy of Sciences, and in a manner entirely satisfactory to the most exacting criticism. The mummy bands on which the inscription is written are reproduced photographically with the greatest care, and the judicious text and commentary by the editor are just what are needed, and no more than are needed, to place all the material for a thorough study of the document in the hands of the reader.

The circumstances of the discovery of the mummy and the inscription have been already briefly referred to in *Science*, Sept. 23. The first who noticed the writing was Professor Brugsch, in 1868; but he did not recognize it as Etruscan; nor did Captain Burton, who published a portion of it in 1879, although that versatile writer was the author of a book on Etruscan remains. Professor Krall, in February, 1891, was the first to make this remarkable identification.

[1] Die Etruskischen Mumienbinden des Acramer National-museums. Beschrieben und herausgegeben von Prof. J. Krall. Wien, 1892. In commission bei F. Tempsky.

The original condition of the book can be restored from its fragments. It was written on a piece of linen, at least 3.50 meters long, by 35-40 centimeters wide. The writing was in columns, so that when the linen was rolled, by unrolling it moderately, one such column, about 25 centimeters wide, could be commodiously read. The writing was done with a reed, and with ink made from carbon, like that which we know as "India ink," and which was usually employed in ancient Egypt. The letters were firm, clear and regular, plainly the work of a skilled caligrapher. The alphabet is that of a high class of Etruscan literature, — quite apart from those degenerated forms which are found in northern Italy. It is probable that the original roll was longer than the fragments indicate, and therefore that they only represent a fraction of the original work.

The linen on which the book is written is of Egyptian manufacture. But as at the date of its preparation Egypt supplied much of the Mediterranean world with the products of her looms, this does not prove that it was written in Alexandria. The question must be left undecided; but there is nothing else Egyptian about the scroll. The text contains no names of Egyptian gods or personages and no sign of foreign influence. It is wholly Etruscan in language, proper names, and general character, and at most may have been an Egyptian copy of an original brought from some Etrurian city.

The text offers twelve columns of about twenty-five lines to a column, six or seven words to a line. A number of the lines are incomplete, others are lost; but enough remains to offer an excellent apparatus to study the language. There are a number of repetitions, as of set phrases, and at the beginning of several paragraphs the Etruscan numerals are found, applied always to certain words of frequent recurrence. The names of various Etruscan divinities, as Nethunsl, Tinsin, Thesan, Usil, Uni, etc., are repeated, indicating clearly that this is some kind of a religious work. Professor Krall pronounces it a ritual to set forth the character and number of offerings (*Opferritual*). From certain arrangements noticeable in the text, I think rather it belongs to the class of works on divination, for which the Etruscan haruspices were so famous.

Something may be added to show the exceptional value of this find.

There is no greater mystery in the whole of European antiquity than that which surrounds the Etruscans. Niebuhr once said that he would willingly part with a large part of his fortune to be able to identify their ethnic relations. Up to the present time, this has been impossible. Not a single theory has been offered which has proved acceptable. Some of the ancients maintained that the primitive Etruscans came from Asia Minor; Virchow has written an article tracing them over the Alps toward the north-east; Dr. Isaac Taylor wrote a book to prove they were "Turanian;" Burton, in his "Etruscan Bologna," tore Taylor's hypothesis to tatters, but did not have better success with his own; and so on with an endless chain of attempted identifications.

The uniform tradition of the Etruscans themselves was that their ancestors came by sea to the shores of Italy, and landed first on the west coast, approximately about 1200-1300 B.C. Thence they extended over central and northern Italy as a conquering race, developing a remarkably high civilization, and finally succumbing to the Romans on the south and to the Celtic and other barbarous tribes on the north. They had settlements as far as the Rhetian Alps, and I have seen in the Museum of Chur, in Switzerland, tombstones with inscriptions in the Etruscan character from that locality. It is true, however, that this is not conclusive evidence; as it is quite certain that some inscriptions in this alphabet are not in the Etruscan language. Their alphabet was adopted by the Veneti, an Illyrian people, and also by the Celts, both of whom wrote in it their own tongues, or at least employed it in their mortuary inscriptions. As the matter now stands, in spite of our possessing over five thousand Etruscan inscriptions, some of considerable length and others bilingual, I do not hesitate to say that there is not a single word whose meaning we positively know.

A true Etruscan inscription was discovered some years ago on the island of Lemnos, in the Ægean Sea, showing that this sea-

faring people had extended their journeys, if not their colonies, to that comparatively remote quarter. This interesting relic has been ably worked up by Professor Pauli, who may be said to be at the head of living Etruscologists.

About the time that the Etruscans settled in Italy, a people of closely similar name, the Tursha, appear in Egyptian history as bold invaders and daring warriors. They are mentioned in the inscriptions of Meneptah II. and Ramses III., and by most writers are considered of the same stock as the Turseni, Tyrrheni, Turaci, or Etruscans. They were allies with the Libyans, and entered the Fayoom with these in the Ramesside period from the Libyan territory to the west. Professor Krall accepts this identification, but adds the cautious and just remark, that we have no positive knowledge of the language spoken by these Libyan neighbors of Egypt at the time mentioned. Of course, if they were the Tursha, and these were the Etruscans, we should see our way much more clearly.

CREMATION OF CHOLERA CORPSES.

BY ALBERT S. ASHMEAD, M.D., NEW YORK.

LET me add a few words to the article of mine, entitled "Cremation of Cholera Corpses," which you published Sept. 2.

I said in the New York *Tribune*, Sept. 22,[1] that religious prejudices should not interfere with the enforced cremation of cholera corpses.

This is what Professor Stillé writes to me about the subject: "In regard to cremation, I have no doubt of its being the proper way to dispose of the dead, and that it originated, as all sanitary laws did, not in divine command, but in human wisdom derived from experience.

"If the Egyptians had possessed fuel, I have no doubt they would have burned their dead, and that the Jews would have followed them in this as in most of their sanitary laws, e.g., circumcision, unclean meats, etc. Of course, with Greeks, Romans, and Christians the doctrine of the resurrection of the dead (most distinct, of course, in the last) led to the preservation of inhumation.

"There are many persons even now who believe in the literal resurrection of the actual body, albeit they are at a loss to give a reason for this popular belief. After all, I doubt if cremation of the dead will become usual. Superstition will hinder it among the ignorant, and tenderness among the refined."

There are in the history of the treatment of infectious and contagious diseases three periods.

1. There was a barbarous period when every, let us say, leper, was considered as outside of the pale of humanity, without any right to the sympathy of his fellow-men, only not killed because there is a law of the Decalogue against killing. The leper, as we have chosen him as the representative of this class of wretches, was condemned to solitude, absolute isolation; if he came by chance within hail of any fortunate healthy brother or sister, he had to ring a bell which he was obliged by law to always carry about him, in order to let them know that somebody was approaching who had no right to approach his fellow-being, and whose presence was an involuntary menace of death! These men were utter outcasts, enemies to be kept off as wild beasts are, completely neglected; when they were found dead, their carcasses were buried — that was the only duty which society performed in their behalf.

2. The second may be called the Mediæval-Christian period. Then something was done for them, in fact everything which those dark centuries knew how to do. *Misericordias* were formed, societies of St. Lazarus, etc. Asylums, hospitals were established. Of course, the greatest service the men of that time thought that they could render their unfortunate brethren was — prayers, the ceremonies of religion. For the ætiology was — visitation of God, punished sin, etc. In a time of epidemic the sanitary measures consisted in holy processions with banners flying, crosses, candles, holy-water; also relics, such as the seamless coat of Treves, a thousand ugly images of the Virgin meeting the traveller at every step. Have not we seen here in New York thousands kissing a bone?

3. The third period is the age of reason, the sanitary period, when superstition, ignorance, and fanaticism must be kept in check, brought to bay, utterly ignored, in every question of public health. We know now what we have to do; there is no excuse for not doing it. If, with the knowledge we have, we pander to the ridiculous pretentions of those who stupidly try to keep up the regimé of the Middle Ages, we are simply criminal.

[1] TO THE EDITOR OF THE *Tribune*: No more salutary measures have ever been taken against the spreading of cholera than the burning of the cholera corpses at Swinburne Island. It is evident that as long as the bacillus has not been entirely destroyed it will live to fight again. However deep it may be buried, at some time it will reach the surface again, get mixed with the water we drink, and cultivate itself in the human body. Why then should a measure so necessary for our safety be limited to such uncared for bodies as those who are found on vessels stationed at quarantine in the bay? The same danger threatens us from the bodies of those who die in the city. There is no use in saying that they will be buried in metallic coffins. Metal may keep the enemy in harmless seclusion for a longer time, but not forever. Moreover, metal renders the process of putrefaction slower, and keeps the bacillus which feeds on the corpse longer alive. There is probably no difference in regard to the danger arising from buried germs, whether the corpse be buried in wood or in iron. Therefore, it is evidently a duty of a board of health which cares truly for the public welfare to enforce cremation of all cholera corpses in the city as well as on the ships. Religious prejudices can really not interfere with that; the body reduced to ashes can resuscitate as well as the body buried, for it is clear that any corpse long before the general resurrection of the dead will be reduced to a condition entirely similar to that which cremation brings about. Or, if it is only the routine of the ignorant that stands in the way, it is the right and the duty of the educated and learned to impose by law and by force what is necessary to the welfare of the whole community. If we must bury our corpses, let us at least bury them in the most rational way possible. Wood decays, iron rusts or bursts, but earthenware jars are absolutely impermeable, and even indestructible. These have been used for more than a thousand years by the royalty and higher classes of Japan, and as we are, just now, teaching the Japanese so much, it is only fair that, when they are entirely in the right, and have given a great deal of thought to the matter, they should teach us something, too. They put vermillion with the cadaver; we might use bichloride of mercury.

SOME POINTS IN CHRONOLOGY.

BY R. W. MCFARLAND.

THE difficulties met with in chronology are best understood by those who have given most attention to the subject. In ancient times each nation was a law unto itself, touching the method of counting time or registering great events.

The Egyptians, several thousand years B.C., knew that the year was very nearly 365¼ days. They, however, dropped the fraction and retained only the whole number. It is said on good authority that this error of one-quarter was allowed to remain, so that by losing one-quarter of a day each year the seasons would slide forward around the whole heavens in 1461 years. By this slow motion of the seasons through the year, the festivals of the gods in like manner would be celebrated in all the seasons, to the end that all the gods should be honored equally and in exactly the same way.

The Roman calendar was amended by Julius Cæsar, 46 years B.C., with and by the aid of an Alexandrian astronomer. We use what is substantially the Roman calendar. It would not be proper in this place to enter into an explanation of the minutiæ of many points in doubt or in controversy. The immediate cause of Cæsar's reform was the vicious habit of the pontiffs in calling out or proclaiming the beginning of the months in such a way as to serve political ends or emergencies. Of course most people who are conversant with the derivation of words know that the word "calendar" is from the Latin *calare*, to call, or to proclaim. As a consequence of the reformation by Cæsar, the year 46 B.C. was made to consist of 445 days, and is sometimes known as the year of confusion. The year 45 B.C., the first of the reformed calendar, coincided in the main with the year 708 of the city of Rome. This is the Julian calendar which was followed in general by the Latin Empire, and was naturally adopted by the various nations after their incorporation into the Roman dominions. The old Egyptian year of 365¼ days was merely transferred to a more northern region, and into a far wider territory. It was not till long after the conversion of the Emperor Constantine to Christianity in the year 320, viz., in the early part of the sixth century, that the proposition was made to count the assumed date of

the birth of Christ, as the beginning of the era — the one now in common use by all Christian nations.

For ecclesiastical purposes the early Christians adopted in part, at least, the Jewish calendar, especially for the feast of Easter, the counterpart of the Jewish passover — the 14th of Abib, the first month of the year. "In the fourteenth day of the first month at even is the Lord's passover."— Leviticus xxiii., 5. But the fourteenth day did not generally fall on the Sabbath. Some churches celebrated Easter on the fourteenth, and some on the following Sunday. This caused some contention, and easily grew into a matter of supreme importance for the church. In the year 325 of our era, the council which convened at the city of Nicæa, beyond Constantinople, decided that the feast of Easter should be celebrated on Sunday, and that it should be the Sunday following the day of the full moon, which should occur on, or next after, the 21st of March. The intention was to fix the time of Easter as nearly as a movable feast could be fixed. The Jewish year was luni-solar — twelve months for one year, thirteen for the next.

Early in the fifteenth century the ecclesiastics noticed that the equinox was slipping away from the 21st of March. The question was discussed more or less for nearly two hundred years before final action was taken. In 1582 the equinox occurred on the 11th of March instead of the 21st, as at the time of the Council of Nicæa, in 325. Pope Gregory XIII., with the aid of able coadjutors, reformed the Julian calendar. His object was to prevent in the future such diversity of days in celebrating the same feast. The change made by Gregory consisted chiefly of two points: 1, The skipping of ten days in order to bring the equinox back to the 21st of March; and 2, To arrange an order of leap years which should prevent a like divergence thereafter. The omitted days were the ten following the 4th of October, 1582. The day which in the ordinary course of events would have been the 5th was reckoned as the 15th of October, new style. The Julian calendar, with every fourth year a leap year, is old style. Gregory excepted the centesimal years, decreeing that only those which are divisible by 400 should be called leap years. The year 1600 being divisible by 4 and by 400 was a leap year in both styles. Wherefore the difference between the two styles continued ten days for a century after 1600, viz., till midnight of the 28th of February, 1700. In new style, 1700, not being divisible by 400, was a common year, and the day following the 28th of February was March 1. But in countries which still adhered to the old style, 1700, being divisible by 4, was a leap year; so the day following the 28th of February was the 29th. Here there began a difference of eleven days between the styles. A like case occurred on the 28th of February in 1800, and the difference became twelve days, and will so continue till February 28, 1900; after which for 200 years the difference will be thirteen days. Russia still adheres to the Julian calendar, and the 12th of October, 1892, in that country will be the 24th in this.

The change of style by Gregory looked solely to the future, in order to prevent unseemly changes in the time or date of church festivals. It did not disturb the past at all, and was not intended to do so. As a proof of this, it may be stated that no date previous to October 4, 1582, old style, was ever changed by Gregory or any of his successors, or by any body of learned men, or of unlearned men; that no writer of history or of chronology in any European nation has changed or attempted to change such dates from old to new style. The discovery of America was on Friday, October 12, 1492, old style. It is so written "always and everywhere and by all."

It was reserved for the American Congress of 1892, instigated by a committee of some ill-informed society, to depart from established and uniform custom, and to declare that the 21st of October, 1892, should be celebrated as the 400th anniversary of the discovery. It is a "consummation devoutly to be wished" that this hasty and ill-advised action of Congress may die a speedy death, and that after this year it may never again be thought of or regarded in any way.

The present Pope, in his announcement concerning "Columbus Day," utterly ignores this act of Congress. He says, according to current reports in the daily press, that on the twelfth of October or on the following Sunday (the 16th) appropriate services will be had in commemoration of the great discovery. It is to hoped that some friend will call his attention to the unadulterated wisdom displayed on this side of the Atlantic, regardless of the "effete monarchies" of Europe.

England adhered to the Julian calendar till about the first of September, 1752. To be specific, the order of Parliament was that the day following the second of September of that year should be called the fourteenth, and that the year which previously began on March 25 should begin on January 1, 1752, to conform to the Gregorian calendar. Macaulay, Hume, Robertson, and all other historians who have written in the English language of events in English history, give the dates in old style up to the year 1752.

In the colonies on this continent, planted by the French, Dutch, Spanish, and English, each followed the custom of the mother country, some using old and some new style. After the Revolutionary War Ramsay's Life of Washington was written. In it Washington's birth is given in old style only, viz., February 11, 1731,— conforming to the English custom of leaving unchanged all dates before the change of style. But "necessity knows no law;" so the conflicting dates of the various colonies were assimilated by all being made new style, for events occurring on this continent.

Such is a brief account of some points in chronology, which account may be of interest to many and may stir up some to a more careful study of a much neglected subject.

Oxford, Ohio, September, 1892.

SOME THOUGHTS ON THE PHYLOGENY OF THE MOLE CRICKET.

BY E. W. DORAN, PH.D., COLLEGE PARK, MD.

I HAVE recently been able to work out to some extent the life-history of the Northern Mole Cricket, *Gryllotalpa borealis*. The various stages of the insect seem not to have been studied extensively, or described, before. I have made some observations of interest which I have not seen recorded elsewhere, and which seem to indicate the course of development in this species. I am led to believe that formerly the insect lived upon the surface of the ground, or in natural hiding places, very much like our common field cricket, instead of burrowing into the earth, and passing all its existence under ground.

My first reason for supposing a change of habit has taken place is based upon the fact that the larva, before the first moult, is able to jump like the field and house-cricket. (Larvæ but little over a fourth of an inch long were seen to jump five or six inches in the breeding-jars.) They are otherwise very active and brisk in their movements. After this stage the insect cannot jump at all, and is very clumsy. It can run rather rapidly backward or forward in its burrow, or upon a level surface, but has very awkward movements upon an uneven surface. The abdomen is long and heavy, especially in the pupa and imago.

Now this would indicate that originally the mole cricket had the power of jumping like most other orthoptera, and all other *Gryllidæ*, I think, and lived upon the surface of the ground, perhaps hiding in crevices, or under rubbish, like the common cricket. But having taken to the burrowing habit, and no longer finding the necessity for exercising its power of leaping, it gradually lost that power, until it appears only in the early part of the larval stage.

My second reason for this conclusion is based upon the habit the mole cricket has of defending itself in the burrow by ejecting posteriorly a creamy, viscid substance in large quantiti— —hich rapidly thickens after exposure to the atmosphere. seems also to have peculiar chemical properties. In t is able to protect itself from almost any foe which may from behind, and it fights viciously if attacked in fro the larva before the first moult does not have the powe ing this substance, and this would possibly indicate previous stage of its development the mature insect armed, for the young larva certainly needs protection a

in later life. This method of defence would not be so effectual upon the surface of the ground where its enemy could attack it from any source instead of directly behind or before, because with its unwieldy body it would not be able to eject the substance in any desired direction suddenly. This, then, appears to be a habit acquired by the insect since it has taken to its underground life; for it is hardly probable that it would be provided both with the habit of making long leaps to escape from its enemies, and at the same time to eject in large quantities this protective fluid.

There are some rather serious objections to this theory of changed conditions and habits. First may be mentioned the unusual development of the tarsus, fitting it for its underground life and burrowing propensities; but it is not unreasonable to suppose that the front legs were developed gradually in conformity with its changing habits. And it is perhaps true that if the insect lived upon the ground, it occasionally burrowed for roots, or for shelter, and originally had an unusual development of the tarsus. Its carnivorous habits may have been acquired in consequence of its frequent contact with earth-worms, when other food was scarce, as there are many other insects which normally feed upon vegetable food, that will resort to animal food, devouring even their own kind, as in the mole cricket, when pressed by hunger.

Second, an observation made by Westwood and others in Europe upon *G. vulgaris* would seem to weaken my argument regarding the development of the insect. It is stated that the larvæ of the European species, before the first moult, live together in one burrow, with the mother cricket, but scatter after this moult. I have seen the very young larvæ of our species only in confinement, and cannot say whether in the natural state they would scatter before this time or not. They run about in the breeding-cage more before the first moult than afterward. However, I think it probable that the mother cricket feeds the young, at this early stage, as she exercises great solicitude for them apparently, in other matters, or in time of danger. I have several times seen the mother take the young in her mouth when disturbed, as a cat does her kitten, and carry them to places of safety. She will also carry her eggs to a new burrow when they have been discovered, as I have several times observed. Hence it seems probable the young larvæ live together under the protection of the mother cricket, and would have but little need of a protective ejection. But the jumping habit which is chiefly useful in escaping from their enemies, being confined only to the early larval stage, presents a stronger argument for changed conditions. I may say, however, that neither of these are presented as conclusive arguments but rather mere suppositions or suggestions, to be followed up by other observations.

THE SCIENCE OF SMELLING.

BY PROF. DE VOLSON WOOD, STEVENS INSTITUTE, HOBOKEN, N. J.

THE greater part of the science of seeing is contained in the science of optics, and this is founded upon the theory of undulations of the ether and the way in which they are modified by the media through which they pass. The form of the surface, whether plane or curved, as well as the density of the medium produces marked effects.

Similarly, the greater part of the science of hearing is contained in the science of acoustics, and this also treats of undulations, or waves propagated in air or other gases. It is not believed in either case that solid particles pass from a source to the sensitive nerves to produce the particular sensation.

Why should there not be a science of smelling? The principal part of such a science would consist of an investigation of the mechanical properties of odors, and might briefly be called ogy." Is it not highly probable that odors are also propa- undulations of an ether? And yet we are familiar with nents made by writers, such as "A grain of musk will om scented for many years. During the whole of the ıust be slowly evaporating, giving out its particles to the of air to be wafted presently out of doors; yet in all this musk seems to lose but little of its weight." "The se of smell of the dog is well known; for he can detect the track of his master long after the tracks have been made, which shows that some slight characteristic matter is left at each footfall."

Those who thus speak impart the idea that odor is material. I prefer to think of it as a property of matter, which produces its own peculiar undulations; and that the sensation of odor is produced by these undulations in the olfactories. Musk retains this property for a very long time, while some bodies lose it rapidly. The man may leave some characteristic matter on the ground at each footstep, but it is not necessary that particles of that matter shall pass from the ground into the nose of the dog in order that he may track his master. It is only necessary that that matter shall possess the property of sending forth certain undulations. Indeed, it is not difficult to conceive that the ground itself has imparted to it the property of sending forth the desired undulations.

These facts being assumed, investigations might be made to determine the velocity with which odors are propagated, and whether they are subject to reflection, refraction, and interference, and other properties common to sound and light; also whether the different odors are due to different wave-lengths, and if the strength and intensity of the odor is due to the amplitude of the wave, as in light and sound. The physiological qualities of the olfactories by which they enable one to detect odors of different qualities and intensities furnish a field for the most delicate and refined investigation.

NOTES AND NEWS.

PERSONS who are very susceptible to the effects of gnat-bites state that the irritation seems to return on the third day, and in those who have exceptionally sensitive skins again on the sixth day. Thus the effects of gnat-bites, or rather of the poison which they instil into our blood, have a certain analogy with the symptoms of intermittent fever. This need, perhaps, scarcely surprise us if we recollect from what materials the juices of the gnat have been elaborated.

— Herbert M. Thompson's "The Theory of Wages and its Application to the Eight-Hours Question," published by Macmillan & Co., is a timely contribution to the discussion of this vital question of the present industrial crisis.

— Lovers of birds and flowers will delight in Miss Yonge's new book announced by Macmillan & Co. Under the title of "An Old Woman's Outlook" she describes out-door life in England as she has watched it for so many years. The chapters are so arranged that each shall cover its special month.

— "Round London, Down-East, and Up-West" is the self-explaining title of a new book by Montagu Williams, barrister, author of "Leaves From a Life," etc. It will be issued by the Macmillans.

— D. Appleton & Co. will shortly add to their list of Good Books for Young Readers "Along the Florida Reef," by C. F. Holder, which is a story of camping and fishing adventures in company with a naturalist in Florida. The author combines entertainment and instruction, and his book is filled with illustrations which will be prized by every young reader who has ever visited the seashore, or cares for information regarding fishes, shells, and the various forms of marine life. The same firm will publish immediately "The Story of Columbus," by Elizabeth Eggleston Seelye, edited by Dr. Edward Eggleston, with nearly a hundred illustrations by Allegra Eggleston. This book is the result of extensive investigations which have been carefully verified by Dr. Eggleston. While the book contains all the results of modern inquiry offered in the bulkiest biographies, the story is here condensed and the material selected with a view to an always interesting narrative. To a considerable extent the plan of both text and illustrations is like that of Eggleston's "Household History of the United States." "The Story of Columbus" will be the first volume in a series to be called Delights of History, which will be prepared by the same author, artist, and editor.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

VON DEN LICHTSTRAHLEN KLEINSTER WELLENLÄNGE.

VON VICTOR SCHUMANN IN LEIPZIG.

Lange Zeit galten die Wellenlängen zweier Linien des Aluminiumspectrums als die kleinsten. Nach den Messungen A. Cornus betrugen die Längen dieser Linien in Angströmeinheiten (1 Angströmeinheit = 0.0000001 Millimeter) ausgedrückt, 1860 und 1852 AE. Für beide Linien ist, wie schon für die ganze Spectralregion des Ultravioletten, das menschliche Auge vollständig unempfindlich. Nur sehr wenigen ist es vergönnt, das Ultraviolett durchs Ocular eines hinreichend lichtdurchlässigen Spectralapparats ebenso deutlich wahrnehmen zu können, wie die minderabgelenkte Region des sichtbaren Spectrums, das, wie allgemein bekannt, von jedem gesunden Auge vollkräftig empfunden wird. Das ultraviolette Licht lässt sich nur auf einen Umwege sichtbar machen; entweder projicirt man es auf einen fluorescirenden Schirm oder fixirt es mit Hilfe der Photographie auf einer lichtempfindlichen Platte.

Das Fluorescenzspectrum kann man direct oder durch eine Lupe betrachten; in beiden Fällen lässt es aber an Klarheit und Schärfe viel zu wünschen übrig. In früheren Jahren, wo die photographische Platte dem nassen Verfahren angehörte und die moderne Trockenplatte noch nicht bekannt war, hat man sich vielfach des Fluorescenzspectrums bedient, wenn es sich um Versuche mit ultravioletten Strahlen handelte. Gegenwärtig, wo die Bromsilbergelatineplatte der photographischen Beobachtung so ausserordentliche Vortheile gawährt, denkt wohl niemand mehr an die Verwendung des unvollkommenen Fluorescenzspectrums.

Die photographische Beobachtung hat die oculare aus dem Ultravioletten vollständig verdrängt. Wer beide Methoden geübt hat, wird mir beipflichten, wenn ich sage: das Fluorescenzspectrum ist viel zu roh, als dass es der exacten Spectroskopie der Gegenwart noch gewachsen wäre.

Die moderne Trockenplatte ist gegen die ultravioletten Strahlen ungemein empfindlich und diese hohe Empfindlichkeit kommt der Spectralwissenschaft ausserordentlich zu statten. Zeigt doch die moderne Trockenplatte allen lichtquellen elektrischen Ursprungs gegenüber ihre höchste Empfindlichkeit nicht etwa im sichtbaren Spectrum, sondern weitab davon im Ultraviolett.

Photographirt man das Spectrum irgend eines Metallfunkens, so entwickelt sich jederzeit zuerst das ultraviolett, und erst, wenn man länger belichtet, tritt das sichtbare Spectrum hervor. Es ist aber keineswegs das ganze ultraviolette Licht, was dem sichtbaren voraneilt. Nur ein Theil davon zeichnet sich durch photographische Ueberlegenheit aus. Alles Licht, das jenseits der Kadmiumlinie No. 24 wirkt, braucht zu seiner Aufnahme beträchtlich längere Belichtungszeit. Die Empfindlichkeit der Platte nimmt von dieser Linie — ihre Wellenlänge beträgt 2266 AE — an mit der Brechbarkeit der Strahlen sichtbar ab, und sinkt, bei Anwendung grosser Aufnahmeapparate, in der Gegend der Wellenlänge 2000 sogar auf Null hinunter. 2000 AE dürfte demnach annähernd die kleinste Wellenlänge sein, die sich mit den gegenwärtig am meisten im Gebrauch befindlichen grossen Gitterapparaten noch beobachten lässt.

Versucht man diese Wirkungsgrenze mit einem kleinen Apparat zu photographiren, dann erweitert sich das Beobachtungsgebiet um eine ansehnliche Strecke, und die gewöhnliche Bromsilbergelatine erweist sich, bei hinreichend kurzer Focalweite und gehöriger Lichtdurchlässigkeit des optischen Körpers, sogar bis zur Wellenlänge 1820 geeignet. Dieses relative Grenzgebiet kleinster Wellenlänge gehört nach umfassenden Versuchen, die ich im Jahre 1890 anstellte, einem Apparat an, dessen Focalweite 180 millimeters (Fraunhoferlinie D.) betraegt.

Der Umstand, dass das photographischwirksame Spectrum um so weiter ins Ultraviolett hinausläuft, je kürzer die Brennweite ist, besagt deutlich, dass der Ort der photographischen Wirkungsgrenze eine Function der Dicke der Luftschicht ist, die die Strahlen auf ihrem Wege zur photographischen Platte zu durchsetzen haben. Versucht man nun, von dieser Thatsache ausgehend, die Luftschicht noch weiter zu vermindern, dann bemerkt man zwar, dass sich die photographische Wirkungsgrenze noch um einige Linien kleinerer Wellenlänge entfernt, allein der Längenzuwachs des Wirkungsbandes ist so unbedeutend, dass der Erfolg die Mühen und Kosten der Herstellung eines derartigen kleinen Spectrographen nicht lohnt. Es gewinnt sonach den Anschein, als habe man hiermit das wahre Grënzgebiet der wahrnehmbaren Lichtstrahlen kleinster Wellenlänge erreicht. Bestärkt wird man in solcher Annahme noch durch die Thatsache, dass das Fluorescenzspectrum ungleich früher, bei Wellenlänge 1852 verlischt, und demzufolge zur Beobachtung aller stärkerabgelenkten Strahlen ganz ungeeignet ist. Stände uns nicht die photographische Platte, sondern nur die fluorescirende Platte zu Gebote, so würde die kleinste Lichtwelle, die wir noch wahrnehmen könnten, nur das Längenmass von 1852 AE haben. Man sieht hieraus, dass beide Grenzwerthe nur eine ganz relative Giltigkeit haben. Aehnlich der fluorescirenden Substanz, die schon von Wellenlänge 1852 an nicht mehr leuchtet, könnte ja möglicherweise auch der photographischen Platte die Fähigkeit fehlen, von Allen Strahlen, deren Wellenlänge kleiner als 1820 ist, einen entwicklungsfähigen Eindruck anzunehmen. Diese Ueberlegung leitete mich, als ich vor nunmehr zwei Jahren eingehende Versuche mit Strahlen des brechbarsten Ultravioletten anstellte, und nicht ohne Erfolg. Es ergab sich hierbei, dass es nur der Mangel an Empfindlichkeit der damals angewandten lichtempfindlichen Platte, keineswegs ungenügende Energie der Lichtstrahlen war, die meine Versuche jenseits 1820 zu keinem befriedigenden Resultate kommen liess. Ich gewahrte ferner, dass die Strahlen schon in der das lichtempfindliche Silberkorn umschliessenden Gelatinehülle erstickten, ehe sie zur Einleitung des Zerfalls dieses Kornes gelangten. Die Gelatine des Plattenüberzugs bildete sonach die Ursache meiner photographischen Misserfolge im äussersten Ultraviolett. Die Kenntniss dieser wichtigen Thatsache führte mich zur Präparation einer neuen Platte, die sich in der Folge zur Photographie aller Strahlen jenseits Wellenlänge 2260 besser eignete, als die vorher benutzte Gelatineplatte.

Die neue Platte verhält sich den Lichtstrahlen gegenüber durchweg ganz anders wie die Gelatineplatte. Wenig empfindlich gegen alle Strahlen des sichtbaren Spectrums und der wenigerabgelenkten Strahlen des Ultravioletten, wächst ihre Erregbarkeit von 2260 an bis in die Gegend von 1860. Bei 1860 scheint sie, wenigstens allen elektrischen Lichtquellen gegenüber—andere Lichtquellen erzeugen niemals so starkabgelenkte Strahlen — die höchste Empfänglichkeit für Lichteindrücke zu besitzen. Weiter nach der brechbarern Seite hin sinkt ihre Empfindlichkeit etwas, doch bleibt die Wellenlänge 1820, bei der die Gelatineplatte aufhört empfindlich zu sein, ohne allen hemmenden Eindruck auf sie. Kräftig und klar gezeichnet, gibt sie das spectrale Wirkungsband auch jenseits 1820. Arbeitet der Spectralapparat mit einem Prisma, dann scheint es, als wollten die Lichtmassen, die diesem,

für das menschliche Auge in ewige Nacht gehüllten Strahlenbereiche entquellen, gar kein Ende nehmen. Mit jeder folgenden Region, die man zur Aufnahme einstellt, meint man das Endgebiet der kleinsten Lichtwellen zu erreichen. Aber es ist fast, als flöhe die kleinste Welle, die überhaupt noch photographisch zu fesseln ist, um so behender ins fernste Ultraviolett hinaus, je näher ihr die Fessel der lichtempfindlichen Platte rückt.

Schon jetzt weist meine neue Platte jenseits 1852 ein Spectrumband auf, dass das gesammte Wirkungsgebiet der Bromsilbergelatine um mehr als das dreifache an Länge übertrifft, und gleichwohl lässt auch die letzte meiner Aufnahmen noch der Hoffnung Raum, dass jenseits des Randes ihrer Platte noch photographisch wirksames Licht existirt. Vorläufig gehört aber diese letzte Aufnahme, ohngeachtet solch' günstiger Aussicht, doch demjenigen Gebiete an, das ich gegenwärtig als die Grenze der kleinsten Lichtwellen bezeichnen muss. Die Photographie des Nachbargebietes hiervon stösst zur Zeit,— aus Grunden, deren Erörterung hier zu weit führen würde, — auf Hindernisse, die sich, sofern es überhaupt möglich ist, nicht ohne grosse Anstrengung werden beseitigen lassen.

Fragt man nun nach dem Masse der kleinsten Lichtwelle meiner Ultraviolettaufnahmen, dann muss ich leider bekennen, dass mir im Augenblick eine bestimmte Antwort hierauf nicht möglich ist. Wellenlängen lassen sich im luftleeren Raume, an den meine Aufnahmen gebunden sind, nicht so leicht ermitteln wie in der Luft, und die geplanten Messungen der Wellenlängen des äussersten Ultraviolett haben darum auch besonderer Vorbereitungen bedurft. War es doch überhaupt zweifelhaft, ob sich die übliche Methode der Messung der Wellenlängen auf den in Rede stehenden Lichtbereich werde anwenden lassen. Meine Vorversuche hierzu gehen zur Zeit ihrem Abschluss entgegen, und die mir vorliegenden Resultate berechtigen zu den besten Hoffnungen. Unter solchen Umständen kann ich das Mass der kleinsten Lichtwelle, die meine Aufnahmen aufweisen, vorläufig nur schätzungsweise und mit Vorbehalt nennen. Es dürfte dieses Mass 1000 AE nicht überschreiten, ja eher kann es um ein gutes Theil kürzer sein.

Der Wellenlänge 1000 entspricht eine ausserordentlich hohe Schwingungszahl des Lichtäthers. Während die brechbarsten Sonnenstrahlen wenig mehr als 1000 Billionen Schwingungen in der Secunde ausführen, schwingt ein Strahl von der Wellenlänge 1000 in derselben Zeit dreibillionenmal. Mit Schwingungszahlen so enormer Höhe hat der Spectroskopiker bisher noch nie zu rechnen gehabt, und gleichwohl liegt es nicht ausser dem Bereich der Möglichkeit, dass wir über kurz oder lang die Wirkungen des Lichtaethers bis in die nächste Nähe der Wellenlänge Null verfolgen werden, wo der ungeheuren Anzahl seiner Schwingungen kaum noch der Massstab des Endlichen gewachsen ist.

THE SOUNDS OF R.[1]

BY ALEX. MELVILLE BELL.

THERE seems to be special need for a better understanding of the sounds of R. No element of speech is so variously pronounced — in dialects and by individuals. The fundamental organic action from which all the varieties are derived is a frictional emission of breath or of voice between two surfaces in the breath channel. Thus we may make an R in the throat,— producing the effect which, when prolonged, is called a groan; or in the guttural passage, between the back of the tongue and the soft palate — a mode which is dialectically common in many countries. A less definite variety is formed between the arched top of the tongue and the roof of the mouth. This is common in the United States. Another — and the normal English form of R — is produced between the point of the tongue and the upper gum. This is sometimes modified by inversion of the tongue within the palatal arch, or by addition of guttural or of labial contraction. The point-tongue R is also varied by advancement of the tongue to or between the teeth. In a common English affectation the seat of R is transferred from the tongue to the lips, so that R has the sound of W. Of these varieties one may be characteristic of a dialect, another a mere individuality, but they are all effects of only one organic action performed at different parts of the mouth.

Another series of R's results from a trilling or rattling organic vibration instead of a mere friction of the breath or voice. Thus a trill of the epiglottis is heard as one form of R; a trill of the uvula is another and very common one; and a trill of the point of the tongue is the regular form of R in North Britain and Ireland. The Spanish R has a more prolonged rattle of the same kind. The trill has often the effect of a syllable; as in Scotch and Irish, where it converts the grammatical monosyllables *world, harm, mourn*, etc., into the phonetic dissyllables wor-rld, har-rm, etc.

These trills involve a strong pressure of breath and a harshness of phonetic effect, in contrast to which is a form of R of simple vowel quality, without friction or vibration; as in (ə)ise and (ə)ound, for *rise* and *round*.

A similar vocalic effect is also heard for R wherever it is not followed by a vowel; as in *here, care, fire, store, tour, are, war, term, first*, etc. The syllable-like quality of this sound is distinctly felt after the close vowel ē, and less distinctly after open vowels, because their mouth-cavities differ so little from that of R.

In Early English R was always trilled, as it continues to be in Scotland, where most of the characteristics of Early English are still prevalent. But in modern English the trills have been softened away wherever R follows a vowel, until little is left of the R but its vowel quality. We are accustomed to the entire omission of R in negro speech, where *do* and *sto* are all that we hear for *door* and *store;* but in educated utterance there is some phonetic effect left in R even where it is least manifest. Such delicate shades of sound are the distinguishing marks of refinement in pronunciation, and they should be carefully preserved by teachers and by writers on phonetics.

In a book recently published in England the learner is taught that R is silent in such words as *farm, serve, lord, prayer, weird*, etc. Had the statement been that the sound of consonant-R is not heard in these words it would have been correct, but the R is certainly not "silent;" it has a phonetic effect of its own, soft and vowel-like, but a quality wanting which the words would not have their characteristic pronunciation.

That there may be no mistake as to the teaching in the work referred to, the reader is specifically told that the words *arms* and *lord* are exactly the same to the ear as the words *alms* and *laud*. Now what is the sound of R which baffles the discrimination of this writer? Let us magnify it, as in a microscope, by prolonging the elementary sounds. First let us put "alms" and "laud" under the microscope: —

a - - - - lms; lau - - - - d.

Here there is no R; the vowel remains unchanged until stopped sharply by the succeeding consonant. Now put "arms" and "lord" under the microscope: —

a - - - - (ə)rms; lo - - - - (ə)rd.

Here between the vowel and the m or d there is interposed a gliding connective sound, so that the vowel is not stopped sharply by the consonant, but its quality is gradually changed by a lift of the tongue, verging towards but not quite reaching the position for R. This is all the sound that R has, in modern English, before any consonant or when final in a word. But it is something more than n o t h i n g; and something that is essential to the correct utterance of any word containing R before a consonant.

Among the sounds of R may be reckoned the influence of R upon other sounds. The mouth-cavity for R being very large, any closer vowel preceding R is, as it were, s t r e t c h e d at the point of junction, so as to assimilate with R. Thus a pure ē is with difficulty pronounced before R; a pure ā is never, in Anglican speech, heard before R, but a is "stretched" to eh, as in *air, chair*. So, too, o and oo before R have a more open than their usual formation, as in old — ore; pool — poor.

These widened sounds of o and oo are distinctly different from the sound of aw; yet in the book before referred to the words *shore* and *drawer* are said to have the same vowel; and the words

[1] [illegible] read before the Phonetic Section of the Modern Language Associa-[illegible]mber, 1891.

your and *yore* are classed as identical in sound. Your, shore, and drawer are thus "phoneticised" into yawer, shawer, and drawer. These words are, indeed, often so pronounced in dialectic speech; but the science of phonetics must be retrograding instead of advancing when, in an "Introductory Science Text-Book," such differences can be ignored, and such mere negligences cited as examples of correct usage.

All short vowels stop sharply on consonant-R, as on other consonants, as in *parrot, very, spirit, sorry, hurry;* but long vowels take on the connective glide even before consonant-R, as in *weary, fairy, wiry, gory, fury.* Thus wea(ə)ry, fai(ə)ry, wi(ə)ry, etc.

The vowel quality inherent in the mouth-cavity of R is that of er-ir in *her, sir.* Consequently, in such words as *firm, yearn,* the r has the effect of lengthening the syllable by making it contain two sounds of the same vowel. Let us put the words under the microscope: —

fi - - - - (ə)rm; yea - - - - (ə)rn.

Test this further by analyzing the syllable "word." If the r were "silent," the vowel would be sharply stopped by the consonant d. Thus, wo - - - - d; but the true pronunciation of this syllable interposes a glide between the vowel and the d. Thus, wo - - - - (ə)rd.

In forming this smooth transitional r the tongue is slightly lifted from the bed of the jaw; therefore when a vowel follows the r, the consonant sound of the letter is also developed; as in feiring = fear-ring There is a tendency among many speakers to finish all open vowels with this lift of the tongue, so that the consonant r is inadvertently interpolated between two words, as in "Pennsylvania-r-Avenue, "I saw-r-it all."

Nice distinctions — like those which are the subject of this paper — are of no importance where mere intelligibility is concerned; for example, in the speech of the deaf. In such cases, the widest differences may be disregarded, so long as the words are understood. But in the study of phonetics, the most minute varieties require to be distinguished, because what in one case may be a distinction with but little difference, may in another become a very shibboleth.

I make no apology for introducing so small a topic to your attention. In a practical subject nothing is too small to be carefully investigated. The whole organism of speech is but small, and the differences of organic action from which the greatest elementary distinctions result are, in actual measurement, exceedingly small.

The sounds of R, with all their differences — rough, smooth guttural, lingual, labial, definite, indefinite — are only one in kind; and we must recognize them in their faintest as well as in their most obtrusive forms.

ON THE SECULAR MOTION OF A FREE MAGNETIC NEEDLE.[1]

BY L. A. BAUER.

A MAGNETIC needle suspended so as to move freely in all directions will set itself tangent to the lines of terrestrial magnetic force. At any particular epoch it will have a definite direction. It wil make a definite angle with the meridian, which, measured in the horizontal plane, is known as its declination, also a definite angle with this plane, which, measured in the vertical plane, is termed its inclination or dip. About this mean position of equilibrium a variety of small periodic variations take place, accompanied at times by fitful or irregular ones, which occasionally become quite respectable. Concerning this we shall have nothing to say. But the needle undergoes another, and by far the largest excursion, requiring centuries for its fulfilment. Since its discovery in 1634 by Gellibrand, as exhibited in the secular variation of one of its co-ordinate angles, the declination, it has been the cause of no end of fruitless speculation. It has engaged some of the best minds and given rise to most ingenious theories, but the riddle is still unsolved.

As the needle assumes different positions for different epochs, it gradually sweeps out in space a cone, whose vertex is the centre of gravity of the needle. Or, if you describe a sphere having as a centre the centre of gravity of the needle, and prolong the axis of the needle until it intersects the sphere, the successive intersections will form some tortuous curve. The geometric nature of this cone, or of this tortuous curve, remains to be investigated. A preliminary analytical attempt was made by Quetelet in 1877. He used fifty years of continuous observations of declinations and dip made at Brussels, and found that a cone of revolution would best fit his observations, the period of a complete revolution being 512 years.[2] Mr. Schott made a graphical attempt for an average New England station, using about fifty years of observation. The scantiness of his material prevented him from making any safe deduction as to the course of the needle.[3]

To our knowledge, however, no attempt has as yet been made for the long series of observation which we possess at quite a number of stations. The usual custom is to discuss *separately* the secular variation of the different magnetic elements, as though they were *different* effects of forces acting, instead of *component* effects. We believe that this, in some measure, is the reason that with 100–300 years of observation no greater headway has been made in the conception of the requirements of the secular-variation problem.

With the view presented of the problem, some of the interesting questions we may ask ourselves are: Will the orbit described by the north end, say, of the needle, be a closed curve or approximately so? That is, will the needle at the end of a certain period assume the same direction that it had before, and again sweep over the same curve in the same length of time? Or, will the needle never return to a previous position, and thus never fulfil a secular variation period? If we have such a thing as a true period, is it the same all over the globe? If we have to deal with *different* periods, as the discussions of declination observations at various stations would seem to indicate, are these local or independent, and thus belong to different systems of magnetic forces? Or, do they but indicate different *stages* in the development of the secular variation, whereby either the period itself is a fluctuating one, or the orbit consists of several branches or loops? If the secular waves travel from east to west, traversing the whole globe, then by making an instantaneous circuit of the earth in an easterly direction, shall we find the needle at every station farther along in its secular orbit? Shall we find a continuously progressive and consistent motion throughout our survey, thus correlating the stations and referring the cause to a common origin? If we find this to be but roughly so, then by selecting as a base station, one where we have a long series of observations, we may with the aid of the shorter series at other stations, by adopting a time-coefficient determined from a comparison of the curves, attempt to answer some of the questions propounded without waiting until centuries have given us a complete period? Finally, what is the law of force acting upon the needle to cause it to describe its orbit?

To carry on a study of the secular variation to the best advantage, it would be highly desirable that at all stations where we have a tolerably long series of observations they be put in the best shape possible by one familiar with the subject and the station. It would then be an easy matter to establish secular variation stations all over the globe, where future observations might be made. This would mean simply the inauguration of a grand scheme, the fruits of which might not be seen for centuries. While such a gathering of material has already been made for many stations, there is, however, abundant material left.

The first station selected for discussion is London, where we have the best series of observations of both elements. The declinations date with Boroughs's in 1580. They can be represented (within their probable error) by the following formula, derived

[1] Abstract of a paper read before Section A of the A.A.A.S., Aug. 18, 1892.

[2] See Bulletins de l'académie royale de sciences etc. de Bruxelles, 47me année, 2me serie, T. xlv.

[3] See U. S. Coast and Geodetic Survey Report for 1885, App. No. 6, p. 272.

from a least-square adjustment of all the observations between 1580 and 1890: —

$$D = +\,6.24^\circ + 17.75^\circ \sin\,[0.7^\circ\,(t - 1850) + 112.7^\circ] \text{ - - - - (1).}$$
$$\pm\,.10 \quad \pm\,.31 \qquad\qquad \pm\,.2$$

Where D stands for the declination at any time t, positive when west, and $0.7^\circ = \frac{360^\circ}{514}$ = angular motion in one year. The differences between the observed and computed values would seem to indicate a fluctuating smaller period of about 80 years, having a variable parameter of about $\frac{1}{2}^\circ$. Somewhat similar results were found at Paris by Mr. Schott, and at Christiania by Professor Weyer. No attempt was made at present to establish this second term, it lying within the probable error, which for a computed result is $\pm\,20'$.

The inclinations date with Norman's in 1576. The observations between this date and 1891 can be represented by the following formula: —

$$I = 70.40^\circ - 3.98^\circ \sin\,[0.7^\circ\,(t - 1850) + 23.0^\circ] \text{ - - - - (2).}$$
$$\pm\,.065 \quad \pm\,.09 \qquad\qquad \pm\,.1$$

Where I = inclination at any time t and the period involved, 514 years — apparently the same as for (1).

The probable error of a computed value is $\pm\,10'$, which, considering the material, is satisfactory. Both (1) and (2) apply to latitude 51° 30′ and longitude 0° 07′ west of Greenwich. The mean of the Greenwich and Kew observations was taken to apply to this station. Comparing (1) and (2), a remarkable result peculiar to this station will be noticed — that the epochs are practically complementary, hence the following approximate relation between the declination and dip can be found: —

$$\frac{\delta^2}{(17.75)^2} + \frac{\iota^2}{(3.98)^2} = 1 \text{ - - - - (3).}$$

Where $\delta = D - 6.24$ and $\iota = I - 70.40$.

From (1) and (2) the following results are obtained: —

	Declination.		Inclination.	
	Amount.	Time.	Amount.	Time.
Maximum	24.0° W.	1817.5	74.4°	1688.5
Minimum	11.5° E.	1560.4	66.4°	1945.7
Range	35.5°	— —	8.0°	— —
Mean	6.2° W.	1689, 1946	70.4°	1560, 1817
Zero	0.0°	1660, 1976		

From which it appears that for London the mean declination takes place about the epoch of maximum and minimum inclination, and *vice versa*.

With the aid of formula (1) and (2) the curve described in space by the north end of a free magnetic needle was now accurately constructed and graphically exhibited. It was shown that the first approximation of the curve could be taken as a spherical ellipse, the period being about 500 years. For Paris, a similar result was obtained and exhibited, using provisional formulæ. For both stations the curve lay to the greater part west of the true meridian, and the direction of the motion (standing at the centre of the needle and looking towards the north end) was that of the hands of a watch, or opposite to that of the earth. A rough survey was then made of the globe in an easterly direction approximately in the latitude of London, and elucidated by a diagram. It was found that the needle was farther along in its secular orbit at every station. The curves for some stations in the southern hemisphere were also exhibited.

The following conclusions were reached: —

1. The direction of the secular motion of the north end of a free magnetic needle in both hemispheres is that of the hands of a watch.

2. That if the secular orbit is a *single closed curve*, then are the periods *different* for different stations.

3. That if the period is a *common* one, then must the orbit be a closed curve of two or more loops lying within each other. We are getting then, at present, a small loop in America and a larger rope.

4. That our present feeling is rather that, strictly speaking, we have no such thing as a *period* of secular variation, but that the needle partakes of a sort of spiral motion, returning approximately to a former position, but never exactly so.

Future study may possibly modify some of these conclusions. The possibilities opened up by such a study as outlined were next briefly alluded to, and reference made to a possible extension of the well-known Gaussian analysis by the introduction of the variable t — time.

In conclusion, can we not say with Sabine: "Viewed in itself and its various relations the magnetism of the earth cannot be counted less than one of the most important branches of the physical history of the planet we inhabit."

LETTERS TO THE EDITOR.

⁂ Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

On Biological Nomenclature.

I HAVE read with interested attention the discussions by botanists in *Science* on this subject. It would appear that they are fully alive to the need of some canons of nomenclature in their branch of biology — a need which has been felt, and supplied of late years, by the zoölogists.

The nomenclature of botany has always seemed to me to be more stable and uniform than that of zoölogy, for the reason, as I supposed, that the naming of new genera and species has, for the most part, been reserved to a comparatively few leaders in the science; and the same cause has contributed to the fixity of botanical classification, in comparison with the incessant taxonomic fluctuations which zoölogy has suffered.

With the late great increase in the number of working botanists, the distinction of a small select "caste" of authoritative namers and describers in botany seems to be breaking down, with the various good and evil results attending this transfer of power from a privileged oligarchy to more democratic rule.

I think that not improbably the botanists who are now exercised over names may examine with much confidence the canons of nomenclature lately formulated and rigidly enforced by the American Ornithologists' Union. These rules have been found to work admirably in practice. They may not be the best possible, but on the whole they are the best extant. A number of leaders in other departments of zoölogy, besides ornithology, as in mammalogy, herpetolcgy, ichthyology, malacology, entomology, etc., have found them entirely available. If some two or three of the rules are not so acceptable as the rest, yet it seems to be generally conceded that it is better to abide by them all, than to dissent from the code as a whole on account of a few comparatively unimportant points that may not be liked so well as the rest are.

Referring to the excellent article of C. H. Tyler Townsend in *Science* of Sept. 16, it seems to me that the moot points he raises have all been considered carefully by the ornithologists, who have settled each of these questions to very general satisfaction; and that the considerations upon which their conclusions have been reached are entirely applicable to the botanical questions involved.

I wish to say a word respecting the somewhat epigrammatic rule, "once a synonym, always a synonym," for the form of which I am measurably responsible, if I remember rightly. Like any other curt sententious saying, the rule is, as I perceive by Mr. Townsend's remarks, liable to be misunderstood. There is no question that, as he correctly says, "If a form which had been described and then thought to be the same as some other species, is later proven to be a valid species, the name originally proposed should stand." Certainly it should. That is not the application at all of the phrase "once a synonym, always a synonym;" and I never heard before of its application to the case Mr. Townsend adduces. What the aphorism really means is best illustrated by a concrete example:

Let there be a genus *Smithia* in botany. Let a genus *Jonesia*

and significance of language. In this part of the work we must find the chief interest in the fact that we have an attempt to theorize as to the origin of speech from the standpoint of its beginning in the lower animals, rather than from the standpoint of its more developed conditions in man. The study of language hitherto has been to reduce human language to its lowest and simplest form. Mr. Garner for the first time attempts to develop language from its simpler conditions in the lower animals, and if Mr. Garner's conclusions differ in some respects from the ideas that have hitherto been in vogue, it is not surprising.

On the whole, the work of Mr. Garner is extremely interesting and suggestive. As a piece of book-making it is open to criticism. It is sketchy; it is not very logically arranged, containing a miscellaneous mixture of observations on the intelligence, habits, gestures, affections, and general mental attributes of monkeys, some of which are new, but most of which are not especially new, and have little relation to the subject of monkey speech. The observations on the actual speech of monkeys, which is of course the really valuable part of the work, fills only a small portion of the book. We must look upon this volume and the work it describes simply as an outline sketch of the beginning of a series of results which may be carried to a successful issue in later years. The thanks of science are certainly due to Mr. Garner for opening to us a new line of research and a new realm of suggestive thought.

H. W. CONN.

Outlines of Zoölogy. By J. ARTHUR THOMSON. Edinburgh and London, Young J. Pentland, 1892. 655 p. Ill.

FOR some years now there has been no text-book of zoölogy in the English language at all adequately representing the present state of the science, and at the same time of moderate cost. The cost of Claus and Sedgwick is high; the translation of Lang must remain incomplete till the original shall be finished; Lankester's promised book still delays its appearance; Packard is out of date, as for that matter is Claus and Sedgwick; and the college teacher who wishes his students to have a good reference book in their possession hardly knows where to turn when the said students combine a comparative ignorance of German with thinly-lined pocket-books. Under these circumstances, the prospect afforded by the announcement of Mr. Thomson's book was distinctly attractive.

It may be said at the outset that the book to a large extent responds to favorable anticipations. Mr. Thomson, while not much known as an original investigator, has made a record for himself in the hardly, if at all, less useful *rôle* of abstractor and collator of the work of others, while his occasional essays and his work with Professor Geddes on the evolution of sex have shown him to possess an agreeable literary style. The "Outlines of Zoölogy" is an exceedingly readable book, and perhaps the only criticism that can be made upon its style is that it occasionally degenerates into flippancy. Professor Forbes was quite justified in making his joke about the "wink of derision" which *Luidia* gave him as it passed over the side of the boat after breaking off its arm; but it is hardly desirable to waste space in repeating the joke in a text-book. A good many examples of this kind might be quoted.

Mr. Thomson wisely, we think, follows the example of Claus, Boas, and other writers in devoting a considerable amount of space to general matters. The first ninety pages of the book are occupied with an account of the functions of animals, the meaning of organs, tissues, and cells, methods of reproduction, fertilization, segmentation, etc., palæontology, distribution, and the principles of evolution. Evidently these subjects must be treated in the briefest possible way; but the result is on the whole not unsatisfactory. The first chapter, however, which takes for granted a knowledge of the meaning of such words as "cells," for example, would be a pretty tough morsel for the average student beginning zoölogy without any biological training. Of the remaining 514 pages (excluding index), 343 are taken up with invertebrates, and 171 with vertebrates — an arrangement which, for a general text-book, surely gives too much space to the vertebrates.

Publications Received at Editor's Office.

BRIDGE, JOHN. From Tilbury to Torbay. London, Gilbert & Rivington. 16°. 154 p.

DE VARIGNY, HENRY. Experimental Evolution. London and New York, Macmillan & Co 12°. 283 p. $1.50.

HOLM, THEO. Notes on the Flowers of Anthroxanthum Odoratum L. Washington Government. 8°. 5 p.

MAINE STATE BOARD OF HEALTH. Seventh Annual Report. Augusta, State Printers. 8°. paper. 44 p.

MUELLER, FERD. VON. Select Extra-Tropical Plants. 8th ed. Melbourne, Australia, Government. 8°. Paper. 602 p.

RAMSAY, ALEXANDER. The Scientific Roll, Nos. 1, 2, 3. Climate, Baric Condition. London, W. E. Bowers. 8°. Paper.

SMYTH, BERNARD. B. Check. List of the Plants of Kansas, Topeka. Bernard B. Smyth. 8°. Paper. 34 p.

TOMPKINS, C. R. The Woodworker's Manual, Dover. N. H. The John A. White Co. 8°. Paper. 60 p. Ill.

U. S. GEOL. SURVEY. Bulletin No. 79. Washington Government. 8°. paper. 39 p.

WRIGHT, G. FREDERICK. Man and the Glacial Period. New York, D. Appleton & Co. 12°. 401 p. $1.75.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale or Exchange.—The subscriber would like to receive cash offers, or an offer in exchange for the earlier volumes of Poggendorf's Annalen and the later volumes of Silliman's Journal, upon the following list: Chenn —Manuel de Conchyliologiè. 2 vols. Nearly 5,000 figures, some hand-colored Paper. Paris, 1859. Edwards.—Butterflies of N. A. 2 vols. Plates hand-colored. Vol. I., half calf Vol. II. in parts. Leyman, Agassiz, Hagen.—Ills. Cat. Mus. Comp. Zoel. at Harvard. No. I. Ophiuridae. No. II., Acalephae. No. III., Astacidae. All bound in one volume. American Naturalist. Vols. I.–VII. Cloth. Silliman's Am. Jour. of Science and Arts. Third Series. Vols. I.–X. Cloth. Binney.—Terrestrial Mollusks of N. A. Colored plates. 4 vols. Stretch.—Zygaenidae and Bombycidae of N. A. Colored plates. Also a considerable library of monographs, reports, and scientific books, and a large number of duplicates of fossils, minerals and shells. E. A. STRONG, Ypsilanti, Mich., Sept., 1892.

Exchange.—I have the finest shells of Anodonta corpulenta, C'p'r, and Suborbiculata, Say, in the world. Will exchange for fresh water, land, and marine shells, in large or small quantities. Have also for exchange 50 varieties of fresh water and land shells from Spoon River, Ill. DR. W. S. STRODE, Lewistown, Ill.

To exchange for books on birds or insects, or fo back volumes of American Naturalist: Ecker's "Anatomy of the Frog," Packard's "Guide," Guyot's "The Earth and Man." Rockhill's, "The Land of the Lamas," Parker's "Biology," Shoemaker's "Heredity, Health and Personal Beauty," Dexter's "The Kingdoms of Nature," all new. M. J. ELROD, Ill. Wes. Univ., Bloomington, Ill.

For Sale.—About 1087 volumes of the private library of Dr. Nicolas León, formerly director of the Museum at Morelia, embracing publications of special value for Mexicologists, like those of Bishop Zumárraga (16th century), of Siguenza y Gongora, of Aleman, etc., the Missal of Spinoza, all very scarce: manuscripts on the history of Michoacán and other Mexican States, on the Tarasco (the Indian language of Michoacán) and several works, of which the only copy known to exist is in this collection. Parties interested in the sale please address DR. NIC. LEÓN, Portal de Matamoras, Morelia, Mexico.

For Exchange—"The Birds of Kansas,"—Goss, for Gray's Anatomy, or Medical Dictionary. Must be in good condition. Address, J. H. SIMPSON, Buchtel College, Akron, Ohio.

Wants.

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WANTED.—A position as zoological artist in connection with a scientific expedition, institution or individual investigations. Experienced in microscopic and all scientific work. References given if desired. Address J. HENRY BLAKE, 7 Prentiss Place, N. Cambridge, Mass.

CHEMIST AND ENGINEER, graduate German Polytechnic, Organic and Analytical, desires a position in laboratory or chemical works. Address 213½ E. 7th Street, New York, care Levy.

A MAN, 36 years old, of extensive experience, having the degrees of A.M. and Ph.D., desires a first-class opening as a teacher of Zoölogy and kindred studies in a college or university. Can furnish numerous testimonials or references as to success and skill in most modern laboratory methods. Address E. W. D., Md. Agr. College, College Park, Md.

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

A YOUNG MAN, with a thorough training in Analytical Chemistry (including analysis of minerals, food, water, etc.), and holding a diploma of the School of Practical Science, of Toronto, and good testimonials, desires a position as Analytical Chemist or as assistant to such. Address to WM. LA[illegible], 16 Washington Ave., Toronto, Ontario.

In treating of each main division of the animal kingdom, the author begins with a classification of the group and general remarks on its biology and characteristics. Then he takes each class in order, and gives an account in some detail of a type-animal, followed by notes on other interesting genera in the class. In the smaller classes, the type may be omitted. Finally the embryology and affinities of the group are discussed. Sometimes the orders also are characterized, especially among the vertebrates, at other times this is unnecessary.

It is impossible to mention fully either the good or bad points of the book in a short review. It is very well up to date in most respects. Résumés are given of important discussions, such as that regarding the origin of the vertebrates, the position of *Balanoglossus* and other Hemichordata, etc. In most cases the treatment of the various subjects discussed is impartial to a degree. We hear something of "anabolism," "katabolism," "maleness," "femaleness," and so forth, but not too much; and the author's opinions are never dogmatically expressed. On the opposite side of the account must be placed the fact that some phylogenetically important groups are very inadequately discussed, apparently because of their small size, the Polyzoa and Brachiopoda, for example. Among the Rotatoria, *Trochosphæra* is apparently not mentioned at all. A feature of questionable advantage is the constantly recurring tables of resemblances and differences between families, orders, classes, and sub-kingdoms. These tables undoubtedly present matters in a striking form, but as undoubtedly they lead to "cram work" in the case of many students. Perhaps this is the reason for their presence. Mr. Thomson says that his book is partly intended for medical students, who, for the M.D. degree in Edinburgh and other British universities, are required to pass an examination in zoölogy. It may be that the tables were inserted with a special view to their requirements. And still another serious defect in the book is the way in which it is mis-illustrated by 32 full-page plates of rough diagrams. None of the illustrations can be called good, some are atrocious.

Still, taking the book all in all, it is perhaps the best lecture-companion for college students in English at present, and it is to be hoped that an American edition may soon be forthcoming.

JOHN GARDINER.

University of Colorado, Boulder, Col.

AMONG THE PUBLISHERS.

To encourage the use of the microscope, which certainly has proved a fascinating hobby for many as well as a most important art for all science-workers, the Bausch & Lomb Optical Company, Rochester, N.Y., has for some time published a hand-book, entitled "Manipulation of the Microscope" (75 cents), by Edward Bausch. That this book has served a good purpose is evidenced by there having been ten thousand copies sold.

— In the announcement of new books and new editions for the holiday season of 1892 the eight-volume set of "The Lives of the Queens of England," by Agnes Strickland, is foremost in J. B. Lippincott Company's list. The work is a reprint of the author's latest revised edition and contains portraits of the queens of England and numerous other illustrations especially prepared for this edition. Dr. Charles C. Abbott, so well known as a most delightful writer upon nature, has a volume of his "Recent Rambles." Most of them were made through the Delaware Valley, the region he has made peculiarly his own, but by way of contrast we also have trips in New Mexico and Arizona, and a wandering through a seaside forest. This is the first one of Dr. Abbott's books to be illustrated, and it contains nineteen reproductions of photographs made by himself. In addition to other important announcements, we note that Mr. W. S. Baker has again laid students of American history under obligations in the "Itinerary of General Washington," which with great pains and accuracy he has compiled from original sources. The work embraces the period of the revolutionary war.

CALENDAR OF SOCIETIES.

Numismatic and Antiquarian Society, Philadelphia.

Oct. 6.—The president, Dr. D. G. Brinton, described a recent visit to the aboriginal jasper quarries in the Lehigh Hills, Pennsylvania. Two sites were examined, in company with the discoverer, Mr. H. C. Mercer, and Mr. Charlemagne Tower, president of the Board of Managers of the Museum of the University of Pennsylvania. The pits at one site numbered about sixty; at the other nearly double that number. Some were eighty feet in length by twenty to thirty feet wide and must have been at least twenty to thirty feet deep. An enormous amount of the material had been excavated and carried away to be worked into arrow and spear-heads. Quantities of quarry rejects were visible, and one work-shop site was visited. The discovery of these quarries adds greatly to the correct knowledge of the archæology of Pennsylvania. Dr. Robert H. Lamborn exhibited and described two copper turtles of singular workmanship, one from the Casas Grandes, the other from Chiriqui, Central America. Both displayed the peculiar character of wire-work in use by the native copper and gold-smiths.

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During the past year it has been found possible to enlist the interest of scientific workers in the success of *Science* to such an extent that more than eight hundred have promised contributions during the coming twelve months. Not only are contributions of merit coming in ever increasing numbers from American scientific men and women, but we are now securing our first contributions, in any quantity, from abroad.

We know that this development in the usefulness of *Science* is appreciated, not only from the many kind letters received, which are always inspiring and which we wish our friends would mark as at our disposal for publication, but from a marked increase in the number of new subscribers.

Science owes its existence to the munificence of two gentlemen, whose names we do not feel at liberty to publish, who contributed very nearly $100,000 toward the support of the paper in its early years. There is no longer need of such liberal subsidizing, but we do need cash subscriptions from all who feel at all interested in a weekly journal of science in America.

There is no question that scientists are cosmopolites and that a journal is the more useful to them the more it is international in its character. As the result of our efforts to develop the use of *Science* abroad, we have recently published articles from V. Ball, Dublin; Edward T. Dixon, Cambridge, England; A. H. Keane, London; David MacRitchie, Edinburgh; Edward Seler, Berlin; Isaac Taylor, York; G. D. Liveing, Cambridge, England; the Marquis de Nardaillac, Paris; Miss Agnes Crane, Brighton, England; E. Trouessart, Paris; J. Edmund Clark, York; and have in hand for early publication a number of papers from prominent European scientific men.

To develop this international feature of the paper an enlargement to twice its present size will be necessary, and an increase of the price to six dollars.

If we can secure a sufficient increase in the number of subscribers we can promptly enlarge and improve *Science* still further, but cannot without, as in the past the work, as will be seen, has been largely a labor of love. Within the acquaintance of each of our readers there must be some one sufficiently interested in the development of what we hope is a valuable means of scientific discussion to subscribe six dollars, and we urge each and all our friends to do what they can to help. If the number of new subscribers is as large as we hope, one-half of the enlarged *Science* would be printed and published in London to facilitate promptness of publication.

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SCIENCE

NEW YORK, OCTOBER 21, 1892.

THE CAUSES OF INFECTIOUS DISEASES.

BY HUGO ENGEL, A.M., M.D., FELLOW OF THE AMERICAN ACADEMY OF MEDICINE, L. PROFESSOR OF NERVOUS DISEASES AND CLINICAL MEDICINE AT PHILADELPHIA, ETC.

THE real causes producing infectious diseases were unknown until the present era. Preventive treatment, where it existed, was based upon empirical observations; and, although the idea of a *contagium vivum* was conceived a hundred years ago, the possibility of a tangible demonstration of the destructive agent underlying all those zymotic diseases which have so often decimated mankind and wiped whole communities from the face of the earth was scarcely dreamed of a few decades since.

To-day medicine may truthfully be called the benefactrix of the human race; and, though we are but on the threshold of the new era, yet enough has been already achieved to prove of eminent value to humanity. Only twenty years ago who would have thought it possible that so dreaded an epidemic as the Asiatic cholera could be prevented from entering a country whose borders it had reached, and that the fatal malady when it had once found victims in a populous city could be limited to the imported cases attacked, and its further progress be halted? Here we had cholera at our very doors; but it could not enter, and a whole continent has escaped its deadly visit. In such great centres of human industry as New York and Berlin, where thousands of strangers daily arrive and depart, a few cases occurred, but the ghastly disease was driven off without its being able to select one more victim!

Such facts prove the value of the achievements of modern medicine, and clearly show the immense progress this science has made. The question naturally occurs to the intelligent mind — how was it possible to achieve what but recently has seemed unattainable? And the answer is — because of the knowledge gained by bacteriology, this new but all-important branch of modern pathology!

Let us glance at the recent discoveries and bring before our mental eye the principles underlying the study of infectious diseases. At the boundary of the animal and vegetable kingdoms there is an immense empire of beings so minute that the naked eye cannot see them, and that the most powerful microscope alone does not suffice to determine the various species. So difficult becomes here the recognition of the individual that for years the most eminent authorities were in doubt how to classify these minute organisms. Are they animals or plants? The weight of testimony has at last decided in favor of the empire of plants. To it belong these micro-organisms, of which millions weigh but one grain, but which have the power of multiplying at such an extraordinary degree that, as Cohnheim has calculated, the breed of bacteria springing from one germ about $\frac{1}{500}$ of a millimeter in length and $\frac{1}{1000}$ of a millimeter in thickness, provided the development and multiplication could go on without hindrance, within less than five days would completely fill all the oceans of the earth, and the descendants of one single micrococcus, whose weight is so little that sixteen hundred millions of them weigh but one grain, would within three days reach the enormous weight of fifteen million pounds! But fortunately nature has placed impediments in their way; they can develop only under certain favorable conditions, otherwise how soon would these diminutive little beings overpower every living organism!

There are two great subdivisions of these microbes, hyphomyceti and schizomyceti. The first, so-called moulds or fungi, multiplying mainly by the aid of spores, are parasites, among which are many that give rise to diseases of the skin and mucous membrane, as favus, thrush, etc. The propagation of the second class — schizomyceti — takes place mainly by division. Most of them have a rod-like form. The Greek word for rod is βακτήριον; hence the term bacterium. But not all have the same shape, and according to their forms they are arranged in six classes: —

1. Micrococci, or cocci, with circular shape.
2. Bacilli, including all rod-shaped bacteria, short or long.
3. Bacteria proper, as which science recognizes only the shortest bacilli.
4. Vibriones, rods of wavy shape.
5. Spirilli, forming short, stiff screws.
6. Spirochaeti, having the form of long, flexible screws.

Modern research with positive certainty has demonstrated the fact that the activity of bacteria is not limited to the production of one kind of processes. While many of them never prey upon the human organism, others are pathogenic, i.e., disease producing; but the first condition necessary to their development is their entrance into the living human or animal body. One class of schizomyceti, the so-called septic bacteria, at once begin their enormous propagation, when death has interrupted the mechanism of life and the organized tissue having ceased all motion is decomposed, decays, ferments, and putrefies. To-day it is a recognized fact, undisputed by any authority, that the process of putrefaction by which the dead organized tissue returns its constituent parts to the inorganic world and thus completes the never-ending circle, is caused by the septic microbes alone. Without them there can be no decay. All our disinfectants, our processes of embalming, our methods of preserving organic substances by complete exclusion of air, are based upon one principle — preventing the development of septic bacteria.

Another kind of these minute organisms gives rise to various chemical changes known as fermentations. The process by which sugar is changed to alcohol and carbonic acid is due to the yeast-plant; when fermented fluids become acid, this change to the vinegar fermentation is caused by another bacterium; that milk turns sour a rod-shaped schizomycete is responsible for; the discolorations noticed on potatoes, cheese, boiled eggs, etc., as well as the blueish and yellowish tint sometimes assumed by milk, and the green and blue color of pus, are produced by bacteria. The remarkable incident which has caused so much religious superstition, viz., that on the holy wafer appeared a drop of blood, simply depends upon decomposition induced by a micrococcus (*Monades prodigiosæ*, Ehrenberg), and is met with also in unleavened bread.

But bacteria do not cause only the decomposition of *dead* organic substances, they extend their fiendish power also to the destruction of the processes of life of the highest organized beings — the human race and the animals nearest to it.

It would lead me here too far to narrate how the discovery was made, and how by patient research and logical reasoning science has at last succeeded in determining the true cause of infectious disease. Suffice it to say that every zymotic malady — be it acute, like cholera, pneumonia, typhoid fever, small-pox, chicken-pox, scarlet-fever, measles, whooping-cough, yellow-fever, intermittent or remittent fever, cerebro-spinal fever, erysipelas, diphtheria, etc., or chronic, like tubercular consumption, cancer, chronic malaria, lupus, etc. — is due to some special micro-organism, which during the process of development and multiplication in the human (animal) tissues gives rise to the formation of ptomaïnes, — highly organized and most virulent poisons, — which in their turn produce the phenomena, the group of symptoms, that characterize an infectious disease. And the more active this process of development, the greater the number of the bacteria introduced into the living organism, the more favorable the soil presented to them, the more virulent is the ptomaïne, the

more overwhelming the effect! We thus have an explanation of the fact often observed that at the beginning of some epidemics, especially of such grave maladies as yellow-fever, typhus, Asiatic cholera, etc., the victims seized by them frequently die within less than an hour after the first symptom has indicated the outbreak of the disease.

How difficult, however, bacteriological investigations are may be judged from the following data. Some of the pathogenic bacteria resemble each other so greatly that the microscope alone, however powerful, does not suffice for their recognition. In such cases the suspicious microbes are exposed to the influence of various coloring processes; and, as each species evinces a behavior different from that of another variety, the result of the coloring tests often leads to the recognition of the species. But even that does not satisfy the modern bacteriologist. Pure-culture and experimental research must be added. After all the microbes present in a diseased tissue have been removed, they are spread over a layer of beef-tea gelatine, where their development is watched under the microscope. If there are several species — suppose three, though there may be many more — it is soon found that on three different spots of the gelatine certain changes are going on. While in one spot a peculiar excrescence has formed, in another a cup-shaped depression is noticed with the gelatine near it dried, and in the third the shape observed is still different and the gelatine surrounding this spot has become more fluid. From these various behaviors the expert can probably recognize which of the three species is the pathogenic one for which he is looking. Certainly in all these researches care must be taken that no other micro-organism can enter the receptacle in which the developments are progressing; and, as the atmosphere constantly contains many kinds of microbes, the reader may have some conception of the difficulties presenting themselves.

After the suspicious species has been recognized on the gelatine soil, a minute particle is taken from that particular spot, and carried to another culture-soil, which may again be some bouillon gelatine, or agar-agar, or a potatoe-skin, or blood-serum, or any similar substance. It may also be noted that the different species evince a natural preference for some soil, while they obtain only a stunted growth in others.

In all these processes every instrument used must be aseptic, i.e., free from bacteria. Under the precautions mentioned the development of the micro-organisms selected from the one spot and transferred to a special culture-soil is again carefully noted, and if the phenomena accompanying the multiplication and maturing in this pure culture correspond with those known as characteristic of the species in question — in the case of an unknown species these characteristics must first be elucidated by special observations — then the experimental stage is entered. A minute particle of the result of the last pure culture is introduced into some animal organism, and if there it gives rise to the lesions and symptoms of the same infectious disease as that in which the bacteria had first been met with, and if later the specific bacteria taken from the blood or tissues of the inoculated and infected animal again behave under pure culture as the original species did, the proof is considered final and complete, and the microbe in question is recognized as the pathogenic element of the particular infectious disease in which it was found.

To illustrate, the sputum of patients suffering from tubercular consumption contains other bacteria besides the tubercle bacilli — the real cause of the fatal malady. A microscopical examination even with the application of some color-tests, while for practical purposes easily concluded and sufficient, if necessary to be done with scientific exactness does not answer every demand; because the species causing glanders, the fatal disease of horses, that of tubercle, of anthrax, and of cholera, at some time or other, have nearly the same shape. One appears a little thicker, another more rounded at one point, a third slightly longer; but, if we remember their minute size, we may imagine how slight the difference must be when one is an immeasurable bit smaller or thicker. In this instance other color-tests aid the expert; for, while the bacilli of glanders take on the coloring without difficulty, those of tubercle and of anthrax have to be exposed to its influence a considerable time. Then the bacilli of anthrax, after the staining, easily yield the color to the influence of acids, but those of tubercle resist the action even of sulphuric acid, while the comma bacilli of cholera soon develop other peculiar characteristics.

Sputa containing the tubercle bacilli were dried, mixed with street-dirt, exposed for months to all kinds of weather, again dried, and finally used for the following purpose. Two small brick houses were erected in Paris some miles apart, and into each one dozen healthy rabbits — A and B — were placed, which all received the same food, water, treatment, and attention with this difference: into the building containing the rabbits A some of the sputum-dust referred to was thrown daily for a week by the aid of a pair of bellows, so as to mix with the air in the room. About six weeks later all these rabbits had died of galloping consumption, while the rabbits B remained in excellent health.

A bacteriological examination showed the presence of the tubercle bacilli in large numbers in the tissues of the dead rabbits. Some of these bacteria, taken for pure culture, were later again introduced into the tissues of other animals, and again caused the outbreak of consumption in them and their final death.

The specific microbes of a great number of infectious diseases have been discovered, while in others the investigations are still being carried on. For the purpose of diagnosis this discovery is of the utmost import, as the presence of the specific microbes in any disease at once determines the true nature of the latter. Then by a careful study of the conditions of development of these bacteria valuable information has been gained, which has proved useful for the purposes of prevention. Thus in consumption we know, if the sputa of tuberculous patients are destroyed, and if the milk and flesh of animals suspected to be afflicted with the disease are thoroughly boiled. that the danger of infection from them disappears. In the same way we have learned that the germs of cholera are not propagated by the atmosphere, but that they must be swallowed to penetrate into the intestines where alone they can mature, multiply, and produce the disease. The knowledge of these facts enables us to prevent the spreading of the epidemic.

A study of the behavior of the bacteria of decomposition has led to the application of modern asepsis in surgery. A wound that is thoroughly impregnated with a disinfectant, i.e., with a remedy which destroys all such microbes, need only be protected against further contamination to insure its healing by first intention, meaning without the development of pus. Many serious operations which were indicated and which would have saved life years ago, while not presenting in their execution special difficulties to the experienced surgeon, could not be performed because the immense pus-discharge which would have followed them would have proved exhausting, and have brought about the death of the patient. Thus it was with operations on large joints, with injuries affecting the abdominal organs, and with lesions of some of the serous membranes, as the pleura, etc. To-day these operations are performed under the strictest aseptic precautions; the hands of the operator and those of his assistants, every instrument and appliance to be used, the external surface above the seat of the parts to be operated upon — all are disinfected and kept free from bacteria. The operation ended and the bleeding arteries secured with aseptic catgut, which is later absorbed, the parts concerned are completely disinfected and the dressing applied, which, impregnated with material that would prove destructive to any micro-organism entering it, is also calculated to exclude the atmosphere. The result is surprising. In many of the most serious operations, those on the brain included, the dressing often is not renewed but allowed to remain for a week or longer, and when finally taken off the parts underneath are found to have healed without a drop of pus having ever been present and without the temperature of the patient having ever ascended above normal, thus demonstrating the absence of all wound-fever, once so dreaded. Hospital gangrene, erysipelas, and puerperal-fever to-day are almost unknown. And this remarkable achievement is due solely to the results of bacteriological studies!

At the present time the most prominent investigators, the celebrated Koch in Berlin at their head, are endeavoring to find the proper remedies with which to antagonize the action of pathogenic bacteria. They are trying to discover a ptomaine which

will neutralize the effect of the pathogenic ptomaïne producing each infectious disease. To relate here the details would carry us too far into the domain of organic chemistry. I may indicate, however, one other method, which, while having the same object in view, promises great success. Take, for instance, tubercular consumption. There are some animals that cannot be inoculated with the tubercle bacilli, because they are protected by nature against them. The question is, What substance in the blood — we believe it to be in the blood serum, that part of the blood which remains after the removal of the red and white corpuscles — of these animals prevents the development of the tubercular malady? If that substance can be isolated, the victory is won. Koch has taken some of the blood serum of an animal thus protected, and by transfusion brought it into the circulation of an animal specially predisposed to and inoculated with the disease. He succeeded in thus greatly diminishing the severity of the latter.

Professor Lister, on returning from his last visit to Koch in Berlin, said to the English physicians listening to his report, among other things, the following: "But while my lips are sealed with reference to the details, that much may I say, that before a few more years are passed the world will stand aghast at the discoveries made in Berlin. I have seen rats in the agony of lock-jaw, after the subcutaneous injection of a drop of fluid, within a few hours run about in perfect health!"

We are undoubtedly on the threshold of a new era, on the eve of a revolution, the greatest medical science has ever seen. The morning of a bright future has dawned; the light is ascending the horizon, and will soon shed its lustre from the meridian!

HOW TO MOUNT BIRDS WITHOUT REMOVING THE SKELETON.

BY ULYSSES O. COX.

To some, no doubt, it will seem useless to attempt to mount more than the skin of a bird; but, having had some experience with both methods, I wish to state what has been my success with the new one. The process is about the same that has been described by others, but the soap preservative is my own invention.

A pair of pointed scissors, scalpel, tenaculum hook, file, wire-cutters, several hooks of different sizes made of stiff wire, two pairs of forceps, one of the ordinary style and another with about one-eighth of an inch of each point bent out at right angles, are the tools that should be at hand. A dry poison should be prepared of one part arsenic and one part powdered alum. An arsenical soap should be made as follows:—

Group one.

Dry arsenic,	2oz.
Cake soap, any good,	2oz.
Potassium carbonate,	½oz.
Air-slaked lime, sifted,	½oz.

Group two.

Corrosive sublimate,	2dms.
Cyanide of potassium,	2dms.

Two or three moth balls, or one dram of camphor.

Put the first group in a vessel with enough water to dissolve it to the consistency of thick cream. Heat and stir until thoroughly dissolved. Dissolve the second group in another vessel in cold water, and when the first group is about cold stir in the second. Put the soap in well-corked bottles or cans. The cyanide of potassium, moth balls, and camphor, are not used for their preservative properties but to insure the specimens against moths or other insects.

A quantity of cotton, tow, wire of different sizes, and plaster of Paris should be at hand. For trial, select a medium-sized bird, say a jay or a robin, and clean off all dirt and blood-spots by first washing in clean water then drying with plaster of Paris. With the tenaculum hook catch the white coat of the eyeball and with a gentle pull remove the eye. Wipe the socket dry. Remove the other ball in the same way. With a wire, punch through the skull in the back part of each eye-socket and stir up the brain well. Fill the eye-socket with the dry preservative and stir it into the brain cavity. If careful, the brain can be so well poisoned thus that it will dry nicely. Fill the eye-sockets with cotton and proceed to the mouth. The forceps with bent points are for use in holding up the eyelids while putting in the glass eyes. Remove the tongue, and with it as much of the trachea and œsophagus as possible. Poison the mouth and throat well with the arsenical soap, and then sprinkle in a little of the powder. If there are any evident fleshy parts, chop them a little with the scalpel.

Open the skin from the tip of the sternum to the vent and push it back as far as you can conveniently. Remove the large muscles of the breast, working down to the wing; this can be done with a few strokes. Cut off as much of the loose flesh from the legs as you can conveniently. Open the abdominal cavity and with a stout hook remove the intestines. All the feathers may be protected from blood by taking a piece of tin and cutting in one side of it a deep U-shaped notch. The points of the U will fit up on each side of the bird. Several sizes of these tins will be found convenient. The intestines may be drawn out on the tin and removed. Wipe out the cavity with cotton, paint well with the soap, and then sprinkle it with the powder. Chop up the flesh at the root of the tail, and work the poison into it. After having thoroughly poisoned it, fill the body cavity with tow. Tow is preferable to cotton because wires are easily passed through it. Turn out the neck, remove the crop, œsophagus, and windpipe, hack up the flesh on the neck, and then thoroughly paint the skin and neck with the soap, and sprinkle with the powder. Your success depends on the care with which you put on the poison. Prepare two wires, one about six inches longer than the bird from head to toe, the other about the length of the bird. Pass the long wire into the bottom of one foot, up alongside the bones of the leg, just under the skin, through the body cavity, up alongside the neck, and out through the skull. Insert the second wire in the other foot in a similar way, but allow it to end in some of the bones of the body cavity. Place a little cotton in the space occupied by the crop, and begin at the neck to sew up the incision in the skin. Sew for a short distance, then fill the cavity underneath with tow or cotton. Be sure to fill it up well, for the parts will shrink some. Continue sewing until the incision is entirely closed.

With the bird on its back, spread out the wings and make an incision along the bones of each, press aside the skin, and poison the flesh well. If the bird is small, the powder is sufficient; if large, the soap should be used; and, when possible, some of the flesh might be removed. The bird is now ready to be set up, and here the method is no different from others. It will be found that, instead of the feathers on the back being displaced and ruffled, they are nice and smooth. A wire passed through the bend of one wing, through the bird and out through the bend of the other wing, then both ends bent over, will hold the wings in place.

As to time, I find that it takes me about as long to prepare a specimen this way as any, but my specimens are very much nicer. When the bird is poised, the tail and wings fastened, and the glass eyes set, there is little more to be done.

I have purposely placed some specimens thus prepared with some moth-infected birds. They have been there all summer, and, so far, are sound. If properly stuffed the specimens do not shrink and appear smaller than the original. If the muscles are well cut apart, the bird will dry just as poised. The largest bird I have tried to preserve in this manner is a great blue heron (Ardea virescens), and it dried nicely. I have several owls thus preserved. In the owls I took the brain out through the eye-socket. While large birds can be preserved in this manner, the method is better suited to small and medium-sized ones. Warblers and wrens, birds with very tender skins, are thus easily preserved. In such small birds as the warblers, only the pectoral muscle need be removed, but the others must be well chopped up and poisoned with the soap. Specimens for study, not mounted, can be nicely preserved by this process, and they are very durable.

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THE COMMUNAL BARRACKS OF PRIMITIVE RACES.

BY S. E. PEAL.

NOWADAYS, when the doctrine of evolution has taken such a firm hold of the scientific world, and the origin of marriage by capture is occasionally under consideration, it may not be out of place to draw attention to the remarkable communal barracks for the unmarried seen over such a large portion of the earth's surface among primitive races.

Many anthropologists have come to the conclusion that man has been from the first a pairing animal, and that the family was the primary unit. Mac Lennan, who has given us so much on primitive marriage, has endeavored to show that marriage by capture arose from a paucity of females due to female infanticide, and that some form of peaceful monogamy preceded it. But the accumulation of recent evidence tends to show us that, after all, Sir John Lubbock's surmise is possibly correct, i.e., that while marriage, or the private right to one particular female by any man, arose by capture, this stage of social evolution was probably preceded by one of communism, as in a small horde or clan. The existence of these singular communal barracks for the unmarried, as possibly the relics of such a stage, appear not to have been realized by anthropologists, hence it is desirable to draw attention to the large stores of information on this question already in hand but not utilized.

Letourneau, in his "Evolution of Marriage" (in the Contemporary Science Series), has exhaustively traced for us the early stages of marriage and the family among the lower animals, showing that it is by no means a peculiarly human institution. The various and peculiar forms of sexual association, past and present, he has clearly laid before us, but singularly enough has entirely omitted all account of these communal barracks, which apparently are unknown to him.

Under many forms and innumerable names, these singular social institutions extend from the Himalayas and Formosa on the north to Australia and New Zealand on the south; from the eastern Pacific and Marquesas to the west coast of Africa; and thus are found among races now classed as distinct, such as Dravidians, Indo-Mongols, Malays, Papuans, Polynesians, Australians, and Africans. Taken by themselves, these barracks for the unmarried are sufficiently suggestive; but when we notice that they are but one out of many peculiar social customs found surviving more or less among all these races, the case is doubly noteworthy, first, as evidence of former racial affinity; second, as an important factor in social evolution generally.

There seems to be internal evidence that their origin preceded monogamy, or marriage of any kind, and thus that some customs may outlast physical and even linguistic characteristics. As might naturally be expected, there has been marked geographical variation, not only in the barracks, but in the allied social customs, some of which have died out entirely. These customs are: Recognized sexual liberty before marriage, pile dwellings, head hunting, platform burial, aversion to milk, blackening the teeth, the double-cylinder bellows, large canoe war drums, tabu, tattooing, etc. Last, but most important of all, there is the universal tabu of these barracks to the married woman. She is not allowed in or, at times, even near them; whereas the unmarried young women and girls are not thus invariably prohibited, and in not a few cases are expected to sleep in them with the young men. In some races they have special houses or "barracks" built for them.

No doubt much remains to be discovered on this subject; but one thing seems to be already certain, that among all these races having "barracks," and where juvenile sexual indulgence is viewed as a harmless amusement, it was not the "horror of incest" which drove them to exogamy. With regard to these so called "barracks," it is necessary to point out that both in structure and function they vary so much that no description of one will cover all, except in so far as the tabu against the married woman is concerned. As a general rule, they are long houses, the recognized sleeping-places of the unmarried young men, council-halls devoted also to guests, and at times skull trophies, the guard-houses among head-hunting races, and canoe-houses in the Pacific.

Among the more civilized Buddhist shans of eastern Asam, the "Chang" is now a semi-temple, and school-house for boys, tabu to women. Among the Abors the "Mosup," 200 feet by 80 or so, is the young men's sleeping-house, also guest, guard, and council-house; among the less warlike Miri, the "Deri" is very similar, and also the sleeping place of the unmarried young women and girls. The Nogas call them "Pah," and being head-hunters in many cases, they are placed at the fortified entrances to the villages, being, as usual, on piles. The Mikirs call them "Tarengs," and the Lushais, "Zalbuk;" in both these cases they are the club-houses of the young men, and, as in most of the other cases, their authority dominates the community, even that of the parents over their offspring after ten or twelve years of age. Under elected heads they control a large amount of communal work, training and discipline of youths, clearing of roads, maintenance of fortifications, bridges, etc.

Amongst the Gouds, Kouds, Kols, etc., the "Damkuria" are the sleeping-places for the young men, boys, and girls, where they drum and dance to their heart's content. In Formosa the "Palangkans" are the guest and council-halls, the sleeping-places of the unmarried young men, issuing orders, and, as in all others, tabu to married women. Among the Battaks of Sumatra the "unmarried young men live together in a large house, sometimes of two stories, which is set apart for them." All over Papua we see the Dupu and Marea in every village as guest, council, and skull-houses, the sleeping-places for the young men, and tabu to women and children. In New Zealand the "Wharre Matoro" is still "the bachelor's hall or barrack, a Polynesian institution;" wharre meaning house, and matoro, "the advances made by young girls to the other sex." In the Louisade Archipelago, the Solomon Islands, and till lately in New Hebrides and Polynesia generally, the feature was common, the "Ti" of the Marquesas, 200 × 80 feet, tabu to women, being indeed fully developed ere marriage was common. Mr. J. Thomson tells us in Proceedings of Royal Geographical Society, Dec., 1884, p. 701, that among the Massai, "the boys and girls up to a certain age live with their parents; at 12 the boys and at 12 to 14 the girls are sent from the married men's kraal to one in which there are only unmarried young men and women. They live in a very indescribable manner till married." So pleasant do they find it that they seldom marry till past the prime of life.

The nomadic Australians are exogamic, and marry by capture or exchange; yet even here we seem to have a relic of the barrack system. Mr. Brough Smyth tells us that "the unmarried young men have a place set apart for them in each camp." Girls may entertain any of them as lovers till married. A man calls a woman of his own clan "Wartoa," or sister, and cannot *marry* her. Yet connections of less virtuous character which take place between them do not appear to be considered as incestuous. "Intercourse between the males and females belonging to the same clan appears to be regarded without disfavor," though *marriage* is very strictly prohibited between them. Thus the Australians, who (as Mr. Horatio Hale observes) are probably a degenerate race, practically live as roving communistic hordes, in which "marriage," or the monopoly of one female of their *own* clan is impossible (though sexual intercourse is permitted), a "marriage" being possible only by capture or exchange from another clan.

While, therefore, the prevalence of these singular communal barracks over such a vast area, and amongst such distinct races is a proof of great antiquity, their being so invariably tabu to the *married woman* amounts almost to a demonstration that marriage arose by capture. Thus what we now call the "wife," was the private property of the successful warrior.

As soon as property in captured spoils was recognized by races wherein there was sexual communism and hence less competition for females, the right of the stronger warriors to keep their female spoils (as wives) would be less disputed, and we may be certain that with the power they would have the desire to tabu to such females the communal quarters of the (unmarried) young men. Naturally it is with some reluctance and hesitation that one ac-

cepts these communal barracks as evidence of a former stage of promiscuity, and the universality of their tabu to the married woman as proof that "marriage" arose by capture; but the evidence all along the line (which is barely outlined here) seems to be irresistible. After all, perhaps, when we recollect that our ideas of incest, chastity, and modesty were pretty certainly as unknown to our remote ancestors as they are to some races even in our own day, it does not very much matter whether the primary "unit" was the family or the horde; if anything the horde is *preferable*.

A feature of the races having these barracks is (as a rule), that there are no juvenile marriages. At 18 or 20 the young women and at 20 or 25 the men settle down as fairly staid couples while yet in the prime of life, and divorces are rare. There are, as a rule, no old maids, and until civilized races appeared upon the scene, there were probably no prostitutes. Possibly a more extended research may reveal traces of the communal barrack system and its accompanying tabu in other countries; but enough has been stated to show that the subject is worthy the attention of all those interested in the question of the origin of marriage and social development.

Rajmai P.O., Sibsagar, Asam, Sept. 4.

THE UTILITY OF VEGETABLE ACIDS IN FOOD.

BY H. J. PATTERSON.

TECHNICALLY speaking, a food is generally described as a substance supplying material for maintaining the vital processes, renewing the waste and forming additional tissues in the animal system. It is a question whether it would not be well to broaden this definition so as to include those substances which serve the purpose of increasing digestibility and assimilation, and of preventing destructive metabolism. If these substances are not worthy of being classed as true foods, it may be well to class them as auxiliary foods. Whether the vegetable acids fall in the first class or in the second is still an open question; but they most probably belong to that of auxiliary foods.

The study of the definite character, quantity, and functions of the vegetable acids which exist in our foods has received but little attention, and consequently their true utility is but little understood or imperfectly defined. In the dietary of man acid foods have generally been considered to simply serve to gratify the senses of sight, taste, and smell, promote the appetite, and contribute to pleasure. It is well recognized that organic acids occur in small quantities in most feeding stuffs, but in the natural state they are generally in combination with bases. In the proximate analyses of foods the organic acids fall into that general dumping-ground of nitrogen-free extractive matter, and, with the rest of the members of that class, have until very recently received little or no attention.

It is a common practice in medicine to use vegetable acids to cause a decrease in the amount of flesh and to retard or stop flesh formation. Again, we know that in some cases these acids are used to facilitate digestion and to give a general toning up of the whole animal system. Some investigators have suggested that these acids have certain fuel values closely related to the carbohydrates, and that their combustion will save the consumption of other materials; this would class the acids as a true food. With the now almost universal use of silage and brewers' grains in our feeding economy with animals, and the considerable quantity of acids in the free state which are formed in the fermentation which these feeds undergo, it is a matter of considerable importance to know the true effect which these acids exert in the animal system, and whether they themselves are foods; whether they exert a beneficial influence on other foods; whether they aid or retard digestion, assimilation, and tissue and albuminoid consumption.

The investigations which have been conducted bearing upon this question have been very few and have not taken up the question as much in detail as it is desirable or as the matter deserves. The first experiment[1] in this line, and the one that brought this subject prominently before the author, was where a dog had been fed considerable organic acids in addition to his other food, exact records of the amount and composition of the food eaten and matter voided kept, with the result that there was produced a greatly increased consumption of the albuminoids. H. Weiske and E. Flechsig[2] performed experiments with a rabbit and sheep, feeding in addition to ordinary food the calcium and sodium salts of lactic and acetic acids; their results varied, but generally large quantities of the acids increased the albuminoid consumption, while small quantities had the opposite effect. A. Stulzer[3] compared the different organic acids found in feeding-stuffs and in the stomach in the artificial digestion of albuminoids, with the result that most of them have a high value. Acetic acid was found to be surprisingly low. We know from the investigations of Woehler and Lehmann that organic salts are changed in the animal organisms into carbonates and pass off as such in the urine. Charles, in "Physiological and Pathological Chemistry," states that oxalic acid, with animals in normal condition and when active oxidation is going on, rarely appears as such in the system, but is burnt into carbonic acid and water.

During the winter of 1891, experiments were made at this station by the author to test the effects of silage in connection with other foods on the digestibility of the different constituents and on the albuminoid metabolism. The foods used were corn-meal, wheat-bran, cotton-seed meal, germ feed, and gluten meal, in connection with corn-silage *versus* the same foods in connection with corn-fodder (stover). The animals used in the experiment were two one-year-old, and two two-year old steers. The silage contained on the average 1.86 per cent free acid,[4] and as the two-year old steers ate on the average from 20 to 25 pounds of silage per day, and the one-year-old steers ate on the average about 15 pounds of silage per day, this would make about 180 grams and 100 grams of free acid taken by the steers, respectively, per day. The two-year-old steers averaged about 950 pounds, and the one-year-old steers about 550 pounds. These quantities of acid are only from ½ to ⅓ as much as were fed in the experiments of Weiske and Flechsig; with the smaller quantities they concluded that the acid served to conserve the albuminoids, and with the larger quantities to increase albuminoid consumption.

The average results of my experiments showed that with the rations containing the corn-fodder 33.7 per cent of the nitrogen fed was stored in the body, while with the rations containing the corn-silage there was only 26.6 per cent of the nitrogen fed stored in the body. From this we gather that even with small quantities of acid in the free state, they do not serve to conserve the albuminoids, but rather to increase nitrogen metabolism. The acid of the silage had a tendency to increase the digestibility of all the food constituents except that of the protein; this was slightly less digestible in the acid ration.

The experiments performed and the data at hand will justify the following summary: 1. Large quantities of vegetable acids, either in the free state or combined with bases, will produce an increased consumption of albuminoids. 2. Small quantities of vegetable acids in the combined state and very small quantities in the free state have a tendency to increase the digestibility of foods and to decrease nitrogen metabolism or conserve the albuminoids. 3. The vegetable acids may, in some cases and to a slight degree, serve as conservatives of carbohydrates through their own oxidation. 4. That exclusive or excessive feeding of very acid foods, such as silage or brewer's grains, is detrimental to the animal, and causes a waste of the nitrogen or albuminoids of the food and of the animal body.

College Park, Md., Oct 8.

[1] Reference lost.

[2] Journal f. Landw, 37, pp. 199-234.

[3] Landw Versuchs., 38, pp. 257-279.

[4] Principally acetic and lactic acids.

ON Tuesday, Oct. 18, there was opened a telephone line between New York and Chicago. The length of the line is 950 miles, which makes it nearly twice the length of any previously in regular operation. Professor A. Graham Bell was present and easily conversed with one of his early associates in telephonic work, who happened to be in Chicago. The formal opening of the line was made by Mayor Grant of New York, who conversed with the Mayor of Chicago at the other end.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

BRAIN AND SKULL CORRELATIONS.

BY S. V. CLEVENGER, M.D.

THE sizes and shapes of skulls afford only unsafe anthropological and psychological generalizations. While the broad, the long, and the round heads are characteristic of certain races, they are even less invariably so than that the Mediterraneans are black-haired and the Norse are "tow-headed."

Heretofore crania have usually been studied as though it were possible to detach them from everything else in the universe. Their relationship to the contained brains, the phylogenetic and embryological development of the brain and skull together, and the influences of the one upon the other, have had but the most superficial consideration. The vast store of facts afforded us by modern biology, undigested and disjointed though they be, will yield unmistakable results if properly considered in relation to cause and effect association.

Every comparative anatomist has called attention to the occipital position of the foramen magnum of the lower vertebrates, and the tendency of this foramen to occupy a position farther forward in the ascending scale of the mammalia, until, in the primates, it is near, or at, the centre of the base of the skull.

In the *Journal of Nervous and Mental Diseases*, April, 1880, in an article entitled "Sulcus Rolando and Intelligence," I called attention to the different positions occupied by this fissure in different brains, showing that the sulcus of Rolando was placed farther backward in the adult than in the younger animal, and that it formed the posterior boundary of the frontal lobe, which, developing as the intelligence was greater, pressed backward upon the parietal and occipital brain, causing the cerebellum to be covered by the cerebrum; the lesser size of the frontal lobes allowing the brain to fall forward in its case, leaving the cerebellum of quadrupeds uncovered, and this same pressure from before backward, projecting the temporal from the occipital lobe, and the temporal, finding more room below, curled under and forward in its growth and forms the fissure of Sylvius. I also noted that this crowding backward of the frontal brain as it grew larger affected the development of the skull, and as the tendency of the animal to assume more and more the erect posture balanced the head upon the more perpendicular spinal column, that the spinal cord necessarily assumed less obliquity of junction with the brain base, until, in some men, the angle of the cerebrum and medulla oblongata is 90 degrees. At the same time, the forehead, by pressure of the brain from behind, had a tendency to become more prominent.

At a meeting of the Chicago Academy of Medicine, March 13, 1891, when a number of convict skulls were being examined, I reminded the Fellows present of the publication mentioned, and stated that if this lessened obliquity of the medulla could be accepted as an index to the greater intelligence of animals, there might also be an osseous adaptation of the occipital bone to the angle formed by the medulla and brain. I therefore arranged the skulls in a series from greater to less angularity of the basi-occipital or basilar process, and was assured by Drs. Lydston, Williams, and Talbot, who were familiar with the histories of the individuals whose skulls were thus arranged, that this estimation of their intelligence was a very good one. With a pardonable desire to fully establish my priority to this announcement, I will mention that there were present Drs. Lydston, Talbot, Moyer, Kiernan, Stillman, Lagorio, Zeisler, Pynchon, and Williams at this March 13, 1891, meeting.

The exterior surface of the basilar process, unless compensated by differences in diploe thicknesses or in some other way, should give a corresponding inclination to the pharynx at the junction of the basi-occipital with the body of the sphenoid, and as many thousand observations would be needed to establish relationships of this kind, I have concluded to ask laryngologists and others who have occasion to frequently examine throats, to keep records of pharyngeal appearances and other data, from which deductions may be made, as follows: —

1. Inclination of posterior pharynx.

First degree, approaching the obliquity found among quadrupeds.

Second degree, obliquity less than first and greater than

Third degree, upright basilar process, or nearly so.

For the present, at least, more divisions between perpendicularity and the horizontal can scarcely be made in the living person, owing to muscular, mucous, and other coverings varying in thickness, enabling rough estimates only. A separate set of observations should be made upon skulls, where sufficient was known of the history to form an estimate of intelligence, the base for measurements being the same as with Camper's angles.

2 Shape of skull — brachycephalic, dolichocephalic, mesocephalic.

3. Size of skull, large, medium, or small for the age, height, or sex.

4. Intelligence.

5. Education.

6. Camper's angle.

7. Other information not included above, as to disease or injury affecting skull or brain, criminality, insanity, etc.

The correlations should be accepted as inter-dependent and not disconnected. For example, instead of intelligence being indicated by a high, wide, bold forehead, there may be hydrocephalic idiocy, and, generally speaking, we may sum up some cranio-cerebral peculiarities thus: —

1. The more erect position tends to move the foramen magnum forward. Increased intelligence and erectness are generally, but not invariably, associated in animals, so the position of the foramen alone as an index has a restricted value.

2. The frontal brain-growth is always associated with increased intelligence, and this development crowds the sulcus of Rolando farther back and pushes the medulla oblongata and pons Varolii into a more and more upright position, provided the brain-growth is greater than that of the skull, for a roomy skull may afford expansion and allow the primitive obliquity of medulla and occipital bone to persist.

3. The adjustment of the skull to its contents is a complex matter, but may be better understood by relating cause and effect as acting upon both more or less simultaneously, particularly with regard to the differences in hardness and developmental changes in both. For example, the beaver's skull and brain seem to have kept pace together so as to render convolutions unnecessary, and the beaver is an intelligent animal. The brain of Professor Leidy was highly convoluted, and appears to have been rendered so by his cerebral being greater than his skeletal growth, and this would seem to have been a family peculiarity, for his brother's brain presented a similar appearance of crowded convolutions.

4. When a juvenile retreating forehead has gradually been replaced in an adult by a more perpendicular one, through education acquired later in life, then the frontal brain may have crowded

and formed more numerous convolutions and fissures in consequence, but the pharynx may not be changed from the original inclination.

5. The softer brain is likely to undergo more rapid changes than the harder skull, either in the evolution of species or the individual, and the mere cranial conformation may or may not, therefore, be an index to brain area and intelligence, and whatever changes may occur in the skull due to brain increase have reference more to enabling the brain to find room in the cranium, so that a higher forehead may render the more erect basi-occipital unnecessary, or *vice versa*, and normal or abnormal growth of brain may raise both osseous portions.

Some mongrel dogs may inherit a larger brain from one parent and smaller brain-case from another, which would account for the deep indentations in their skulls, the pressure causing them sometimes to suffer from epilepsy and other brain derangements; this disparity is not likely to be so great in the offspring of bettermated species.

6. Many other matters could be considered, such as centres of ossification and cartilaginous persistence between such parts as the basilar process and sphenoid, enabling adjustment of the pharynx to the changed medulla angle.

70 State Street, Chicago.

INDICATIONS OF A RAINY PERIOD IN SOUTHERN PERU.

BY A. E. DOUGLASS.[1]

It is sufficiently easy to assert that at some remote period this country had abundance of water; but very few writers have taken the trouble to point out the actual indications to that effect.

There are two causes which operate to make this climate dry. The first is found in the south-east trade-winds being stopped by the high mountain ranges in the interior to the east of us. The second consists in the fact that the winds which do reach our sea-coast come from the colder regions to the south, and consequently will take up moisture and not deposit it. Therefore, a change from a wet to a dry climate was probably caused by a considerable increase in the average elevation of the Andes. If such was the case it must have occurred at some very remote period.

Before entering fully upon the subject, it is safe to remind one's self that a small amount of water acting through a great length of time can accomplish almost as much wearing as a great amount in a short time. Therefore, the numerous large and deep ravines in this region do not necessarily indicate a great quantity of water at some past epoch.

The purpose of this paper, then, is to point out some particulars which indicate that at some geological epoch there was abundance of water in this region. Unmistakable evidence has been found in two places: on Charchani and on the Pampa of La Joya.

A trip to the observatory meteorological station on Charchani, at an altitude of 16,650 feet, reveals many interesting facts. The green valley of Arequipa seems to be alluvial flats of river and perhaps lake deposits; the pink-colored pampa of Uchumayo is evidently the original volcanic tufa; while the dark-brown pampa, stretching out some ten miles from the mountain and containing a very thin vegetation, is an enormous "wash" from the mountain itself. In this is shown a water action on a scale surpassing anything that can be found about the city itself. If Charchani is a remnant of an ancient crater-ring, as seems not improbable, then a portion half as large as the present mountain has been washed down into the valley.

But there is a still more noticeable feature on the mountain itself. At an altitude of about 14,500 feet, on the ridge west of the great central ravine, the road passes for perhaps half a mile through an area of bowlders worn by water action into all sorts of curious and fantastic shapes. The rest of the ridge to its top is a regular glacial moraine of gravel and bowlders. On leaving this ridge and reaching the final slope to the summit, a little below snow-line, one finds every ledge of rock smoothed and polished on the surface, with long shallow scratches pointing down the mountain — proofs of glacial action. These striated ledges are especially noticeable at and just below the meteorological station. Therefore, at some period this pocket where our station is, between the main summit and the broken ridges to the east, was filled with ice to a depth of a thousand feet or more. This glacier slowly moved downward, completely filling the valley and at some point separating into two streams, one of which filled the great central ravine down to the spring, Canchero, and the other turned more to the west, going down probably to the same altitude of 13,200 feet.

Now the significance of an enormous glacier on Charchani is this: ravines and river valleys can be made by a small amount of water acting through a long period, but glaciers cannot; the water, or snow, must be all there at once. Moreover, the greater the supply of snow for a glacier the farther down the mountain it will come. Now, the temperature of this spring at noon of April 13, this year, was 45.5° F., and it will be shown later that the land had a less elevation in the rainy period than at present. The climate could not, therefore, have been colder. As this glacier came down to an altitude where the mean annual temperature was considerably above freezing, as shown by the present temperature of the spring, the snow supply must have been not merely moderate but quite abundant.

If we had rain enough at the present day to make these dry pampas the gardens they might be, this glacier would be seen on Charchani.

The evidence to be found on the Pampa of La Joya is equally conclusive but not equally striking. Not far below Vitor is a large ridge of volcanic mud to the west of the track. This ridge runs about north-east and south-west, and is bounded along its south east side by an open cliff where the bank has been caved away by a river flowing against it. Stretching away from this bank is the old river-bed, very broad and shallow. At a higher level, to the east of the track, the river-bed contracts into a narrow and deep channel. A surface river on the Pampa of La Joya would necessitate vastly more abundant rains than at the present day. There must have been a supply greatly in excess of the loss by evaporation or sinkage into the earth.

There are other facts also which bear on this question. Lake Titicaca once covered many times its present area. Innumerable shell-fish lived in its waters, whose remains are now found as fossils at Chililaya, Huancané, and other places, many feet above the present lake-level. The signs of this increased size are still so evident and the fossils are so much like the living species of shell-fish, that, geologically speaking, the rainy period which caused this increase and at a lower altitude supported a tropical vegetation was recent; historically, of course, its antiquity was immense. The palaces and houses on the island of Titicaca were built with the lake at practically its present level, and Tiahuanaco is not more than 150 feet above it. Coal deposits are found on the island of Titicaca and at Sumbay, but the tropical vegetation which formed them must be placed in a past so remote that the enlargement of Lake Titicaca and the glaciers on Charchani are but as yesterday.

In the beginning of this article I referred to the fact that an increase in the elevation of the mountains to the east of us may have caused the climate to become dry. That such an increase has occurred in recent geological times can scarcely be doubted. From above Tambo station down to the present sea-level traces of surf-action may be found. That means that the coast has been gradually rising out of the sea to the extent of 1,100 feet in recent geologic times. Whether it did it with perfect regularity, by occasional periods of rapid rising, or by sudden elevations, a thorough examination of the region would show. At Mollendo it is evident that the coast has not risen more than two or three feet in the last hundred years, if it has risen at all, and the fact that guano has been accumulating on the islands along the coast for many thousand years indicates that for a long period the coast has been practically stationary. Nevertheless, there can be no doubt that the last change in the coast-level was a rise of 1,100

[1] First assistant at the Boydun station of the Harvard College Observatory, Arequipa, Peru.

feet. That, to be sure, was not very much, but it must have materially altered the relative lengths of the wet and dry seasons.

Thus we have direct evidence to the following effect: For many thousand years, going back far beyond the recognized period of human habitation, the climate has been very much as it is at present. That was preceded by a slow rise of the land out of the sea, which caused the climate to change from wet to dry. But under the wet climate the elevation of the land was still too great, and perhaps the duration of the epoch was too short, to produce a luxuriant tropical vegetation; otherwise there would be to-day extensive coal-fields. However, the wet climate was sufficient to greatly alter the face of the country. Lake Titicaca was of enormous area, fed perhaps by the melting glaciers. In the almost continuous rainy season, huge turbid rivers roared and tumbled down these western slopes of the Cordillera, while on each mountain summit vast quantities of snow fell, only to pursue its way down the steep slopes, carving out valleys, building up ridges, and by its melting wearing out deep ravines, which grow smaller as they become lost in the broad level plain below. Under such luxuriance of moisture the valley of Arequipa must have teemed with animal and vegetable life, the barren hills to the south were clothed in green, and the desert of La Joya blossomed like a garden.

CURRENT NOTES ON ANTHROPOLOGY.—XVII.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The Ancient Vans.

THE people who in proto-historic time lived at the foot of Mount Ararat, on the plains around Lake Van, and about the head-waters of the Araxes, were known to Herodotus as the Alarodi, which is a Greek form of the Assyrian *Urartu*, of which Ararat is the Hebrew form. They seem to have called themselves Chaldeans, *Chaldi*, but their language was neither Semitic nor Aryan. They learned to write it in cuneiform characters, and a considerable number of their inscriptions have been recovered, dating 750–850 B.C., about.

In a late number of the *Zeitschrift für Ethnologie* is a valuable contribution to our knowledge of these inscriptions by Messrs. Belck and Lehmann. The former traversed some five thousand kilometers of Russian and Turkish Armenia last year, and carefully copied quite a number of hitherto unknown Vannic inscriptions; to the decipherment of which Dr. Lehmann devoted himself with much success. They date from half a dozen different reigns previous to the destruction of the Vannic kingdom by Tiglath-pileser in 742 B.C.

The most interesting, the longest, and the most difficult to decipher, on account of the new words and ideograms it contains, is one from the stele of Rusas. It apparently was set up to celebrate the completion of some important works in irrigation and laying-out of gardens and orchards.

The inscriptions are carefully reproduced in autotype, and offer new and valuable materials for students of this little-known tongue.

Laws of Human Evolution.

The most valuable summary of the facts and laws of human evolution that I have seen for a long time is contained in the Cartwright Lectures for 1893, delivered by Professor Henry F. Osborn of Columbia College, New York. These admirably clear and able addresses, three in number, discuss the many knotty questions involved in this topic with temperate judgment and a complete mastership of the facts.

Many of his conclusions are of the utmost importance to the practical anthropologist, and to the majority will have a novel force; for instance, that man is anatomically quite degenerate, only his hand and his brain comparing favorably with mammalian anatomy generally. He is now in a state of very rapid evolution, or rather transformation, for, according to our author's figures, more than thirty of his organs are degenerating to twenty which are developing. This action is especially active in certain centres, of which eight are mentioned; but in them the rate of change is by no means uniform. The most conspicuous variations are reversions, and in the matter of advance, the evidence is abundant that structure lags far behind function.

In the muscular system the evolution of a new type consists in the accumulation of anomalies in a certain direction by heredity. There are on the average nine anomalies of the muscles in each individual. How these come about is variously explained. The French theory that all anomalies reproduce earlier normal structures, seems too absolute. Here comes in the puzzling question as to what is the active force in producing variations, and preserving those which are valuable to the species. After a careful review of the evidence, the lecturer reaches the conclusion that the theory of use and disuse, along with the hereditary transmission of acquired variations, encounters less difficulties than that of the accumulation of fortuitous favorable variations by natural selection.

Of course, the theories of Weissmann, that acquired traits do not become hereditary, have to be considered, and are not found to be sufficiently established.

Suggestions for a Universal Language.

The evolution of linguistics is in two opposed directions; on the one hand, there are societies and patriotic guilds constantly cultivating and preserving dialects and isolated languages, printing papers in them, and trying to make the rest of the world learn them; and, on the other, there is a growing party demanding that some one or a very few tongues be adopted for the general commercial, social, and scientific business of the world. The latter class is again divided into those who would select one or two of the already existing languages, and their opponents, who think a new and simple tongue had better be manufactured for the purpose. Of the latter the *Internationale Weltsprache Gesellschaft* of Vienna is among the most active. It has just issued a "Grammatik der Weltsprache" (Mondolingue), which is but one of its many publications in favor of the tongue devised by Dr. Julius Lott, from whom (Wien, II. 2. Schüttelstrasse 3) these publications may be had.

Professor A. MacFarlane of Austin, Texas, has also a valuable paper in the Texas Academy of Science Transactions, on "Exact Analysis as the Basis of Language." He reaches the conclusion that a natural language is better suited to scientific development than one which is artificial. Another recent writer on the same subject is M. Raoul de la Grasserie of Rennes, France.

Languages of the Gran Chaco.

The extensive district in northern Buenos Ayres called El Gran Chaco, "The Great Hunting-Ground," has been linguistically almost a *terra incognita*. Inhabited by numerous roving tribes of uncertain affinities, up to the present time we have had of its numerous dialects only one published grammar, and for it no corresponding people could be found, none who speak the tongue which it sets forth!

This want has now been happily filled by two publications which have been issued by the Museo de la Plata; the one, a work composed in 1856 by the Rev. Francisco Tavolini, entitled "Reglas para aprender à hablar la Lengua Moscovita;" the other, by Samuel A. Lafone Quevedo, "Principios de Gramatica Mocovi." Both refer to the same dialect, better known as the Mbocobi. It is closely allied to the Abipone and Toba, and is a member of the stock which, in my "American Race," I have designated by the Tupi term, "Guaycuru."

The two works are in a measure supplementary, Mr. Lafone Quevedo having made use of previous writers, principally Barcena, Dobrizhoffer, and Tavolini, to form his analysis of the tongue. He is also the editor of Tavolini, and holds out the promise of other grammars of the Argentine languages, from unpublished sources. We who interest ourselves in such studies, shall look forward with interest to this series, and hope that the financial storms of the Argentine Republic will not delay its appearance.

The Origin of Punishment.

The young science of ethnologic jurisprudence is one of the branches of anthropology destined to throw unexpected light on the origin and significance of many of our daily customs and beliefs. A most important contribution to it has recently appeared from the pen of Dr. S. R. Steinmetz, on the early development of punishment ("Ethnologische Studien zur ersten Entwickelung der Strafe." Leiden, 1892). It is the second volume of the work, which, for various reasons, has been published first. His aim has been, first, to offer to students an extensive collection of facts drawn from the customs of primitive peoples regarding the question of punishments; and, second, to analyze their sociologic and psychologic significance.

The present volume begins with a chapter on blood revenge, tracing its development into the ordeal and the trial by battle up to the modern duel. The effects of blood revenge on social condition are pointed out, some being highly advantageous, others evidently injurious. The administration of punishment by the state is treated with much clearness and from a wide range of reading. It is shown to have developed from the systems of correction adopted in the primitive family, and was often in the nature of a compromise or blood money. Several chapters of special interest relate to the position of woman with reference to family feuds and revenge, and the authority over the males which she exerted in various communities, some of matriarchal, others of patriarchal constitutions. The intense bitterness of her feelings, and her ferocity, far ahead of that of men, are referred to and illustrated. The punishment of slaves and that of military discipline are also discussed. A curious closing chapter is added on the punishment by the gods, in this world and the next, and its influence on human punishments. It will be seen from this brief reference how extremely interesting the book is.

SCENTS AND THEIR RECOGNITION.

BY J. W. SLATER, LONDON.

THERE are some points connected with both the production and the recognition of odors by animals which seem to need further study. It is agreed that all species possessing the sense of smell at all, like and are attracted by the scent of their usual food, or of substances of a similar character. We have also evidence that animals are agreeably impressed with the specific odor of their own species, or of their own race or strain. On the other hand, they are disgusted and repelled by the emanations of hostile species.

These are results which we might expect on evolutionist principles, and which we actually detect whether we ascribe them to Professor Jäger's "soul-particles" or not. It is sometimes forgotten that peculiar odors not merely aid in the diagnosis of different human races but contribute no little to keep such races asunder. That the odor of the Negro or of the Australian "black-fellow" is repulsive to the white man is a familiar fact. But the aborigines of South America distinguish in the dark the smell both of the Negro and of the white man from that of their own race, and dislike the two former about equally. Even the two great branches of the white race, the Aryan and the Semitic, have a different and in many cases a mutually repulsive odor. During the recent anti-Semitic agitation in Germany and Austria the *Fœtor judaicus* did not escape comment.

At the same time we observe a few cases which we cannot well account for on the principles above laid down. Instance the feline group; the natural food of all such beasts is the flesh and blood of animals recently killed, and even in case of need, carrion. We might expect that beings habituated to such a diet would prefer odors not merely unlike but opposite to those which mankind select. Yet the fact remains that not merely the domestic cat but the leopard is passionately fond of the very same perfumes which we enjoy. Lavender, thyme,—in short, most plants rich in essential oils have a well-known fascination for the cat. Leopards have been charmed into docility and submission by means of lavender water. The difficulty becomes the greater if we reflect that nothing similar has been observed among the canidæ which have a much more acute sense of smell than the cats. I suspect, though I cannot furnish distinct proof, that the plants in question act upon the felidæ as aphrodisiacs. What may be the reason why cats so persistently browse away *Nemohila pulchella?* Its cultivation in London suburban gardens may be pronounced impracticable except under the protection of wire-screens.

THE PERCOPSIDÆ ON THE PACIFIC SLOPE.

BY CARL H. EIGENMANN, INDIANA UNIVERSITY.

THE Percopsidæ have hitherto been known from a single species having a very wide distribution. This species was discovered by Agassiz and described in his "Lake Superior."[1] He considered it a generalized type and relic of an older fauna. Professor Agassiz says (285): "Now the genus *Percopsis* is as important to the understanding of modern types as *Lepidosteus* and *Cestracion* are to the understanding of the ancient ones, as it combines characters which in our day are never found together in the same family of fishes, but which in more recent geological ages constitute a striking peculiarity of the whole class. My *Percopsis* is really such an old-fashioned fish, as it shows peculiarities which occur simultaneously in the fossil fishes of the chalk epoch, which, however, soon diverge into distinct families in the tertiary period, never to be combined again. . . . Now my new genus, *Percopsis*, is just intermediate between Ctenoids and Cycloids; it is, what an ichthyologist at present would scarcely think possible, a true intermediate type between Percoids and Salmonidæ."

During the past summer I made a series of collections of fishes through south-western Canada and the north-western United States. I collected in the streams emptying into Hudson's Bay and the Gulf of Mexico on the Atlantic side, and into Puget Sound and the Columbia River on the Pacific side of the continent. *Percopsis guttatus* Agassiz was found to be abundant in almost all the streams tributary to Hudson's Bay, from the Red River of the north to the Saskatchewan at Medicine Hat. In the Bow at Banff, at an elevation of 4,500 feet, it was no longer seen. The species seems to belong to the plains. It extends south to the Delaware River and Kansas, but is only rare south of the Great Lakes. It was not found in the Columbia at Revelstoke or at Golden, where collections were made, and which are nearly directly west of the localities where it was found to be so abundant, nor was it expected in these localities. When on my return trip I came to Umatilla, where the Union Pacific leaves the Columbia, and I noticed the favorable conditions for collecting, I concluded to stop, although the place was not on my itinerary and I would have but a short time for collecting. The Umatilla is a small stream which expands over a sand strip to form a shallow lagoon before emptying into the Columbia. I reached the station Sept. 6, at 5.20 P.M., and began work at once, as it was necessary to leave again at 4 the next morning. I was more than surprised to find that one of the most abundant fishes was a species of *Percopsidæ*, and that by this find the known habitat of this family was extended to the Pacific slope. Fishing was confined to the lagoon at the mouth of the Umatilla and to the Columbia immediately above this place. During the short time at my disposal over one hundred specimens of this family were obtained. No specimens were found in the Snake and its tributaries. It is really surprising that a species so abundant should have escaped detection till now unless its distribution is quite limited, as its absence at Golden and Revelstoke seems to indicate.[2]

The specimens prove to belong to an undescribed genus. The genus is more specialized than *Percopsis*, but still bears out Agassiz's idea of the family. It approaches much nearer the *Percidæ* than *Percopsis*, in that its dorsal and its anal fins are armed with strong spines, and its scales are much more ctenoid. In other words, its percoid affinities are much more pronounced than are

[1] Lake Superior: Its Physical Character, Vegetation, and Animals, Compared with Those of Other Regions. Boston, 1850.

[2] The elevation of Umatilla is given to be 300 feet by the Union Pacific Railway estimates.

those of *Percopsis*. The genera may be distinguished as follows: —

A. Dorsal with two feeble, slender, unbranched rays; anal with a single similar ray; scales most strongly ctenoid on caudal peduncle; posterior margin of preopercle entire or with feeble crenulations; form slender. *Percopsis*.

AA. Dorsal and anal each with two very strong spines; scales most strongly ctenoid on anterior part of body; posterior margin of preopercle with a few short but strong spines; form heavy, deep. *Columbia*.

Diagnosis of *Columbia transmontana* E. and E., sp., nov.: —

Head, $3\frac{1}{3}$–$3\frac{1}{2}$ (3 in the young); depth, $3\frac{1}{2}$–$3\frac{3}{4}$ (4 in the young); dorsal, II., $9\frac{1}{2}$; anal, II., $6\frac{1}{2}$; scales, 769–44 to 46–7.

Body comparatively deep, the dorsal profile more arched than the ventral, making an angle at the origin of the dorsal fin; sides compressed, caudal peduncle most so. Head short and chubby; eye equal to snout, about $3\frac{1}{2}$ in the head. First dorsal spine about equal to the pupil, second spine one-half length of head, recurved and very deeply grooved behind. Anal spines somewhat lower than the dorsal spines; ventrals reaching past vent. Nape, with the exception of occipital spine, scaled. Translucent in life. Color generally smutty. Side with three rows of more or less oblong blackish spots, the middle and superior rows most noticeable. Back with a series of similar spots, one being conspicuous at beginning and end of first dorsal. Dorsal mottled, caudal barred. Head smutty, a blue-black spot on middle of opercle, a narrow, silvery, lateral band. Young translucent, with well-defined dark spots.

The greater part of the specimens belong to the British Museum.

MICHIGAN MINING SCHOOL.[1]

THE committee appointed by you to act as a Board of Visitors to the Michigan Mining School respectfully report as follows: Finding it impossible to arrange a date which would enable the entire committee to make the inspection at the same time, two of us visited the institution on Wednesday and Thursday, March 30 and 31, and the third on April 8 and 9. We were cordially received, and every effort was made to place us in possession of the items asked for and appertaining to the duties assigned us. The examination was as careful and searching as time would permit.

The first visit was made during the progress of the regular work, and the second during examination week at the close of the term. Thus the opportunity was afforded the committee of witnessing the work of students in the class-room and laboratories, as well as the results of that work as exhibited by the examinations. So far as we are able to judge, the work of the institution is being pushed along its legitimate lines and solidly and conscientiously performed both by students and instructors. The lectures indicated carefulness of preparation and thorough understanding of the subjects taught on the part of the instructors, and the character of the examinations showed that there was no disposition to accept less from the students. We were favorably impressed with the earnestness of purpose which seemed to pervade the students as a body, and with the manifest fitness of the members of the faculty for their special lines of work. Some of these men, we understand, left much more lucrative positions on account of their love for their specialty, and their desire to devote themselves exclusively to it. Such men cannot fail to do strong work. It was with regret that we learned, soon after our visit, of the resignation of Dr. Keller. He is unquestionably one of the ablest men in the institution. The building, rooms, laboratories, apparatus, and machinery all indicate efficiency on the part of those having them in charge. The Mining School is purely and distinctly a professional school, having for its object the practical training of its students in mining engineering, and we believe it is carrying out the purpose for which it was established. Of course, much of the theoretical is taught, but so far as your committee could learn, it is with sole reference to its practical bearing upon what is to follow.

[1] Report to Hon. Ferris S. Fitch, Superintendent Public Instruction, Michigan, by a committee consisting of D. A. Hammond, Perry F. Powers, and S. E. Whitney.

Although much time is spent upon theoretical mathematics, the object is to give the student a mastery of those principles which will be necessary in his after work of surveying and engineering. The students are then taken to the field and into the mines, and, under the guidance and direction of an expert (Professor Denton), are taught the practical applications of the principles learned, and other necessary operations of mining. The same methods prevail in the other departments of the school. It is this element of practicability in all the work of the school, in our opinion, which has brought to the school the very general support of the people of the Upper Peninsula and of mining men in particular. The consensus of opinion among all classes is that the school has a direct and financial value to the State. It promotes intelligence in methods of mining, develops inventiveness in the line of mining machinery, and directs thought to measures for securing greater safety to miners.

Your committee, or at least one member of it, before visiting the school had always regarded it as an expensive one considering the number of students enrolled. But after careful investigation at the school and an examination into the methods pursued by the Board of Control, there can be do doubt but that all means appropriated have been economically and intelligently expended. Of course it is well understood by all that technical education is necessarily much more expensive than general education, on account of the peculiar character of the work. The equipment, including buildings, laboratories, apparatus, machinery, and collections in geology, is very costly. A comparison of the per capita cost at the Michigan Mining School, however, with the cost at other similar institutions shows that the Michigan school is among the cheapest. This cost will decrease as the number of students increases. The faculty as at present constituted could undoubtedly handle a larger number of students than are now enrolled in the school (76), and yet the work of the various departments could not be satisfactorily performed with a less number of instructors. In fact, were it not for the union of the school and the geological survey, the faculty would have to be increased; but this arrangement adds to the teaching force for a large part of the year three skilled assistants, Drs. Lane and Patton and Professor Seaman.

This brings us to the consideration of the question of the union of the mining school and geological survey. We believe this arrangement to be mutually advantageous and a direct saving to the State. It places at the head of the Survey, as State Geologist, the Director of the school, Dr. Wadsworth, who is eminently qualified both as to scholarship and executive ability for the positions he holds, and strengthens the faculty of the school by adding to the teaching force the three capable members of the survey. With the means at the command of the Geological Board it would be impossible to retain the services of these men; but by dividing their time between the survey and the school, and receiving a part of their salary from the survey and part from the school the State is enabled to retain them in its employ. It also furnishes convenient headquarters for the survey and places at the service of the school its valuable geological collections. At no other place in the State could this collection be so well preserved and made of such practical value. The wisdom of locating the school where it is, is apparent to all who have ever visited this region. It is surrounded by some of the richest copper and iron mines in the world, and the student has the opportunity of making constant practical application of his studies. Some means, however, should be adopted at once to reduce the expense of living to the students. We understand that it is very difficult for the students to find rooms and board without paying exorbitant prices therefor. If means could be devised for relieving this condition of things it would be well, in fact, it is almost imperative that something be done in this direction. There ought to be a room at the building, also, large enough for an assembly-room. There are many occasions when it is quite important to bring the students together in a body. We believe, also, that the heating apparatus should be removed from the main building and placed in a building by itself.

The Michigan Mining School, we may say in closing, has come to stay; because it has demonstrated its fitness to live. Whatever

may have been its weakness in the past it is now doing valuable work. It is well equipped, has an able Faculty, and a demand upon it greater than it can now supply. We see no reason why it should not be a very valuable auxiliary in the future development of the mining resources of the State.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

On the Interpretation of the Markings on Mars.

IN view of the large mass of conflicting observations of Mars now being reported, it occurs to me to mention one principle of interpretation which has not to my knowledge been suggested. On Mars, as on the moon, may it not be true that the most conspicuous permanent markings are due, not to land and water surfaces, but to contrast of mountain and plain? Mars through even a large telescope is brought scarcely closer than the moon appears to the naked eye, and it presents a general marking analogous to the "man in the moon," which we know to be but a shadow feature. (See, for example, Plate xxxiii. in *Astronomy and Astro-Physics*, October, 1892). If the permanent water surface of Mars is only one-half the area of the Mediterranean Sea, as lately estimated by Professor Pickering, it is, of course, impossible that the light and dark patches represent land and water; but the supposition that they represent, in general, open plain and rugged hill-country throws light on certain perplexing phenomena. The so-called canals are then probably mountain ranges separated by plateaus, and the so-called duplication is a bringing out by higher powers of outlying spurs and ranges, which with lower powers are either indistinguishable or mingled with the general mass. As our seeing improves, we may expect triplication, quadruplication, etc. An observer on Mars looking through a telescope at the Rocky Mountains from a distance of 100,000 miles would discern merely a long dark blur, while upon closer scrutiny he might distinguish parallel and off-shoot ranges with their foot-hills as separate dark lines, which might be termed "canals." The apparent straightness and regularity of the "canals" is doubtless the effect of distance.

By this interpretation we solve the difficulty suggested by Professor Pickering in *Astronomy and Astro-Physics*, October, 1892, p. 669, that some "very well developed canals cross the oceans." These "canals," then, are hilly peninsular extensions or ranges of mountainous islands. From Mars, Italy or Java would appear but as dark streaks in a greenish or bluish medium. Mr. Barnard mentions in the same number (page 683) that "long luminous streaks" seem to be a definite feature of the planet's surface. These are probably lines of snow-capped peaks. We must, on the whole, believe that the seas, lakes, and canals of Schiaparelli's map are as mythical as the seas of the moon.

When one compares the extremely diverse drawings of Mars given in the October *Astronomy and Astro-Physics*, one cannot but suspect that clouds have a large part in producing this diversity. The general appearance of the earth from Mars would certainly change from hour to hour from this cause alone. Predominant and cloud fog probably caused the "absolutely colorless, dark-gray" appearance of the Martian oceans, noted by Professor Pickering for a considerable time (*Astronomy and Astro-Physics*, p, 546 cf., p. 669). Similarly the North Atlantic, which might often appear from Mars as a blue or green spot, might for some time, in the spring of the year especially, be a dark-gray patch.

We must consider it likely that some of the rapidly darkening spots which Mr. Pickering observed were due rather to springing vegetation caused by showers on barren tracts than to inundation, particularly the case he mentions where a dark area suddenly appeared to the "south east of the northern sea and of fully double its area." It seems hardly possible, if the snows on Mars are as light as Professor Pickering represents, that such extensive inundations could occur; and it is simpler and more in accord with general analogy that many such temporary dark or gray-green spots should be due to vegetation rather than to water.

Professor Pickering did so admirably with his 13-inch instrument, that we may well believe that, if he had had a 30 or 40-inch telescope, he would now be able to give us a tolerably accurate account of the general physiography of Mars. We hope his appeal for a thorough equipment will meet a ready response.

HIRAM M. STANLEY.

Lake Forest University, Oct. 11.

The Lines on Mars.

IN *Science*, Sept. 23, Mr. C. B. Warring communicates a theory to account for the gemination of the so-called canals of Mars. He suggests that the phenomenon may be due to a defect in the eye of the observer by reason of its possessing the power of double refraction in some or in all directions. That some eyes do possess the power of double refraction is a well-known fact. It is a defect which, I imagine, is much more common than is generally supposed. It may be suggested that data representing a large number of cases *might* show astigmatic eyes to possess the power of double refraction more frequently than others. I do not know that any data have been collected upon this point.

Concerning the existence of the canals of Mars and that they are sometimes really double, I have no doubt. My own recent work at the Lick Observatory has convinced me that they are not illusions due to imperfect eyesight. During the present opposition, I spent about thirty nights in the work on Mars, working with Professors Schaeberle and Campbell. On about half the nights I saw the so-called canals with more or less distinctness, but on only one occasion did I clearly see a canal double. This was August 17, when the canal called Ganges on Schiaparelli's map was clearly seen to be double, and was so drawn in my note-book. That the doubling was real and not apparent is evident from the fact that Professors Schaeberle and Campbell both saw the same canal double on the same night, and drew it so. Other canals, some of them nearly parallel to Ganges, were seen that night, but none of them appeared double.

Our work was done independently. In turn each went to the telescope, and made a drawing of what he saw. We did not see each others' drawings, nor did we talk of what we had seen. It was not until the next morning that we learned that each had seen Ganges double. WILLIAM J. HUSSEY.

Leland Stanford, Jr., University, Palo Alto, Cal.

A New Habitat of the Black-Throated Rock Swift, Micropus Melanoleucus.

AS curator of the museum, I have just procured for the State University of Nebraska a set of bird-skins prepared during the past summer, among which are five skins that must be of interest to ornithologists. They verify the discovery made by Professor Lawrence Bruner of the University of Nebraska, that the White-throated Rock Swift builds and breeds in the precipitous bluffs around Squaw Canon, Sioux Co., Nebraska, and, what is more likely, throughout the Pine Ridge regions, as Professor Bruner has observed them also at Crow Butte, near Crawford, Nebraska.

This isolated habitat of the White-throated Rock Swift, Micropus Melanoleucus (Panyptila Saxatilis), is several hundred miles east of its most eastern limits as known hitherto. Perhaps the Pine Ridge Buttes and bluffs, particularly those about Squaw Canon, are so admirably adapted to their nesting and high-flying habits as to be the attractive forces.

Although five specimens were secured, no eggs were found. It should be mentioned, perhaps, that the egg of this swift is unknown. However, it is the expectation of the author that they will be found on some of his own, or some of the other numerous excursions sent annually to this excellent field by the university.

The nests are built high up in the cliffs, in the most inaccessible places. The semi-lithified sandstone of these buttes is easily excavated; and, as nearly as could be learned, the swifts dig back about eighteen inches, the opening barely admitting the hand but expanding somewhat at the nest. The nests are built of grass.

As their early name implies, these swifts are all wings; accordingly the swiftness of their flight is such that the best shots make many misses and few hits. It took several rounds of ammunition for the five just added to the State collections. These specimens are all males, and inasmuch as their measurments differ slightly from published measurements, i. e., length 6.50–7.00 inches; extent, 14.00; they are given below for each bird:—

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Length,	$6\frac{1}{4}$	$6\frac{3}{8}$	$6\frac{1}{4}$	$6\frac{3}{8}$	$6\frac{1}{4}$
Expanse,	14	$14\frac{1}{4}$	$14\frac{1}{8}$	$14\frac{3}{8}$	14

From the foregoing measurements it will be seen that, while the length is less, the expanse is greater than those published. These swifts were first observed by Professor Bruner while on a government entomological expedition in the summer of 1891. At the direction of Professor Bruner his ornithological assistant, Mr. J. B. White, shot and prepared the above specimens this past summer. Being in charge of the Morrill geological expedition sent to this region by the University, I had occasion to fall in with Professor Bruner's party, and to observe these swifts personally. We must have seen several hundred at Squaw Canon flying in and out among the buttes which rise with nearly vertical walls five hundred to twelve hundred feet above the Hot Creek Basin.

Having occasion to visit this region several times annually with parties of students, it is to be hoped that we may obtain data for further notes, and that it may be possible to secure their nests and eggs, in spite of their inaccessible abodes.

ERWIN H. BARBOUR.

University of Nebraska, Sept. 30.

Star 1830 Groombridge.

IN *Science* for Sept. 30, I note the letter of Professor A. W. Williamson, in which he propounds an hypothesis, admitted by himself to be forced and unwarranted by any natural facts, to account for the incredible velocity attributed to the Star 1830 of Groombridge's catalogue. It is not necessary to resort to such untenable speculations to explain the phenomena referred to. The only reason for assigning such an extreme velocity to the star in question is the fact that it exhibits quite a large proper motion and no appreciable parallax. It may be, however, merely a case of masked parallax. If we suppose the star to have a large dark companion (numerous instances of which are known, as Algol, Procyon, etc.), we only need to assign to it a period and radius of revolution closely approximating that of the earth in its orbit, and a favorable position of orbital plane, to render the parallax quite imperceptible by the old methods. In such case the spectroscope might solve the problem by determining the orbital velocity, and thence the other elements, in case the plane of the orbit lay in our direction, and thus show that this star is really one of the nearest in the heavens to our system.

HENRY H. BATES.

Washington, D.C., Oct. 5.

Dr. Brendel's Photographs of Auroras.

IN your issue of July 22, 1892, you copied from *The Scottish Geographical Magazine* an interesting notice of the expedition made by Dr. Martin Brendel and Herr O. Baschin to Bossekop on the northern coast of Norway, last winter, to study the northern lights and attendant phenomena. Therein mention was made of the photographs of the aurora obtained by Dr. Brendel.

By his courtesy copies of some of these pictures are before me. Dr. Brendel modestly regards them as valuable chiefly for what they promise for the future. He hopes to visit the Arctic regions again with a much better equipment. But he has already achieved a great feat in securing even these photographs, the first of the kind ever taken. Tromholt's attempt in 1885 cannot be regarded as a success. The faintness of the light, the quivering and shifting of the auroral rays, and the non-actinic quality of certain colors, combine to make this a very difficult task. Dr. Brendel

does not say who manufactured the plates which he used; but they measure four by five inches. With a steady, diffused glow on an arch he has had very fair success, with an exposure of between forty seconds and five minutes. With a greatly agitated, curtain-like display, and an exposure of only one minute, he lost all detail. But a very sharp picture was secured, with an exposure of six seconds, of one end of an arch, which was composed of radiant streamers; the structure is distinctly shown. The pictures were obtained between Jan. 4 and Feb. 1, this year. On the night of Feb. 13-14, a heavy snow-storm prevented observations of the famous aurora of that date; but, as has already been mentioned, a remarkable magnetic disturbance was recorded by the needles.

The scientific world will wish Dr. Brendel good luck in his future endeavors, and will watch eagerly to see whether he finds it practicable to determine the parallax of auroras by this method.

JAMES P. HALL.

Brooklyn, N.Y., Oct. 8.

BOOK-REVIEWS.

The Horse: A Study in Natural History. By WILLIAM H. FLOWER, Director of the British Natural History Museum. New York, D. Appleton & Company.

THE "Modern Science Series," edited by the distinguished scientist, Sir John Lubbock, is not primarily designed for the specialist, nor, on the other hand, for the class of readers that reads merely to be entertained. It attempts rather to supply accurately, yet in language divested of needless technicalities, such information as is needed by everyone who desires to keep fairly abreast of the progress of modern knowledge.

The name of the author of the present volume is in itself a guarantee of the accuracy and interest of its contents, and in the reading we are not disappointed; for within 204 short pages the horse and its relations to nature are presented in a sketch which is at once attractive and thorough.

In the first chapter the ancestral relations of the horse are especially considered; the second chapter discusses chiefly the horse's living allies; while the third and fourth chapters are devoted to structural features. But what adds unusual interest to the book is that the bearing of the facts upon the origin of the horse is in every chapter constantly kept in view. "The anatomy and history of the horse are . . . often taken as affording a test case of the value of the theory of evolution, or, at all events, of the doctrine that animal forms have been transmuted or modified one from another with the advance of time, whether, as extreme evolutionists hold, by a spontaneous or inherent evolving or unrolling process, or, as many others are disposed to think, by some mysterious and supernatural guidance along certain definite lines of change."

The conclusion is forced home to the reader that the horse is a very highly specialized type derived from a generalized ancestor by slow and gradual change, or evolution. The one-toed animal was once five-toed, and its heel was less raised above the ground than now; its teeth were once fitted for a much wider range of diet; its neck was short and a collar-bone, now absent, was once present; its tail was long; its brain — and especially the cerebrum — was small; instead of the open plain, it frequented the shady or often marshy borders of lakes and streams.

The various pages in the history of this evolution are presented as they have been recorded in the book of nature till at last the genealogy is traced back to the five-toed and otherwise generalized type, *Phenacodus*,, of early Eocene age.

The work is illustrated with twenty-seven clear, well-selected cuts, of which that of the quagga deserves especial notice as being from the first photograph known to have been taken from the living animal.

The external appearance of the book is unusually attractive.

TO THOSE INTERESTED IN SCIENCE.

[Science (weekly) established in 1883, N. D. C. HODGES, 874 Broadway, New York City.]

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
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Great Lakes, Origin of the Basins of.
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Hemipterous Mouth, Structure of the.
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Insects in Popular Dread in New Mexico.
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Iowa Academy of Sciences.
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Keller, Helen.
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Maize Plant, Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
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Mineral Discoveries, Washington.
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Palenque Tablet, a Brief Study of.
Patent Office Building, The.
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Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Weeds, American.
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Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

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SCIENCE

NEW YORK, OCTOBER 28, 1892.

THE HUMMING-BIRD'S FOOD.

BY MORRIS GIBBS, M D.

THIS article refers to the ruby-throat, the only representative of this interesting family in our State. Much has been written regarding the food of this species, and yet I am satisfied that but few accurate notes have been offered to the readers. The writer offers observations taken with a view to learning of the feeding habits, and does not pretend to assert that others' notes, however conflicting, are not correct. Locality has everything to do with the habits of birds, and the requirements of the same species may differ vastly in a slight variation, either in latitude or longitude. Again, the resources of a region may radically alter the food habits of any and all animals. Certain it is, that my observations convince me, contrary to all writings that I have seen, that the food of the ruby-throated humming-bird is mainly honey, and that these little fellows do not rely to any extent on an insect diet.

Years ago I captured several in our flower-garden with my insect net, and, in accordance with the views of all books read, they were offered insects as food, but invariably completely ignored everything of this nature set before them. No matter whether I gave them the liberty of a large room or confined the frightened creatures in my hand or a small box, the result was invariably the same; all insect food was refused, whether small beetles, or even those minute flies or gnats, often common about honey-producing flowers. However, on releasing the captive, it would immediately visit the flowers, and appear to revel in the exploration of the deep recesses of the fuchsias and trumpet-creepers. One immature specimen that I caught would sip sugar-water from my hand, and even protrude its delicate tongue for the sweets to be so easily had. This young one was so very unsophisticated that it had to be taught regarding the honey-water, by dipping its tiny, slender beak into the sticky mass, after which it quickly learned. The old ones only fluttered in my hand, and would not eat, but would apparently enjoy that which was forced into their bills. But, left to themselves and watched secretly, they could be seen indulging in the sweets provided for them. If held carefully and an insect forced between their mandibles, they invariably ejected it with a snap of the bill and a side jerk of the head.

Of the wild flowers of Michigan, there are many species which the hummers visit regularly, but as nearly all of these flowers are so far from my residence, it follows that my observations are mainly made from our house-plants and garden flowers. Of all of the uncultivated species that I know, the flowers of the wild crab-apple are most sought after by the ruby-throat, and during the season, about the middle of May, a hundred birds may be seen in a few hours about a group of these trees. There are very few insects on the crabs, and in wet days none, and yet the hummers swarm about. They must come alone for sweets. One point in relation to my theory of the hummer's love for honey would seem to receive a challenge, and it is, that the ruby-throat rarely hovers over the common red and white clover. Now, as we know, red clover is one of the sweetest of flowers, and a head is agreeable to anyone's palate, while the white clover is a great favorite with the honey-bee. My reply to this is, that the individual flower is too small for the ruby-throat's attention.

On our piazza in the city are a number of house-plants, some growing in a hanging-box, others in pots on a stand, while several species of out door perennials and annuals flourish in a bed just below, and a large creeper clambers near. It is safe to say that from early morning till evening twilight there will be an average of one visit every half-hour by the hummers to this collection. So unsuspicious have they become that one can study them at a yard's distance. One advantage in observing them is that they always make their presence known by their pleasant humming and a faint, sharp chirp; thus warning one when to lay aside the book and watch their movements.

On first appearing, they immediately dash towards the fuchsias, which are their greatest attraction, and the next best is the trumpet-creeper, and then the selection appears to them indifferent, as the pelargoniums, nasturtiums, morning-glories, and others are visited indiscriminately. However, the fuchsias are first choice, and, wondering at their preference, I examined the blossoms thoroughly for insects and sweets. In very few cases, and at rare intervals, I found small insects, as no others can reach the heart of the flower; but in every case I met with a most refreshing nectar,— to be sure, in very small quantity to us, but to a hummer, a most plentiful supply. Let my readers pluck a full-blown fuchsia blossom, and cutting into the calyx near the stem end, apply the part to the tip of the tongue, and they will be fully convinced why the hummer is partial to this beautiful pendant flower.

Thinking to test their fondness for sugar, some was dissolved and then dropped deeply into the blossoms of the creeper. In the course of the hour, in their rounds, the busy birds found the bait, and fully thrice the amount of time was spent on the extra-sweetened flowers as was occupied over those of nature's honeying. The sweetening attracted many insects in the course of the day, principally ants and small flies and gnats, but not one instance of their capture could I detect, although careful record of the number of insects in each flower was kept, and the flower examined after each bird departed.

The movements of the hummers when visiting a bed of flowers are interesting. With a dash it is among us with the characteristic impetuosity of its kind, but it is not then detected by the ear, as the noise of a flying bird is but slight and not always heard. It is when the bright, red-throated fellow stops in mid-air that we hear his rapidly-vibrating wings, always loudest when he makes a sudden side-movement from flower to flower. Selecting a flower, after a second's inspection of his surroundings, a rush is made toward it at a very rapid rate, but just as we think he will fly past or against the blossom, he stops—stops instantly. In the fraction of a second he introduces his tiny, but long, slim bill into the heart of the flower, and then is away to the next. The swiftness with which this delicate bird travels about, exploring hundreds of flowers each hour of the day, and from early morning till twilight is truly a marvel.

At each insertion of the tiny beak, his mobile tongue is thrust out and from side to side, and the sweets, and, I think, some pollen, are drawn into its mouth. The tip of the tongue is peculiarly and beautifully constructed for this purpose, and with the perfect adaptability of its slender, delicate bill, the bird is endowed with the means of securing sweets, possessed by no other group of birds.

In conclusion, I will say that I have carefully dissected many humming-birds, both old and young, but have never found anything to convince me that the birds lived on insects. It may be that at times when flowers are scarce some species of insects are captured, but I am satisfied that in season, when flowers are abundant, that the ruby-throat of Michigan lives on honey.

Kalamazoo, Michigan.

THE ORIGIN OF THE CAVE FAUNA OF KENTUCKY, WITH A DESCRIPTION OF A NEW BLIND BEETLE.

BY H. GARMAN.

It is common in writings on the origin of the cave fauna of the United States to assume that the recent formation of the caves of Kentucky is evidence of a similar recent origin of the blind animals which inhabit them. The geological evidence appears conclusive that the caves of the Green River region, and those to the northward in Indiana, were occupied during the Champlain period with water, and that their present inhabitants (at least the air-breathing species) must consequently have taken possession after the caves were elevated and the water no longer completely filled them. There can be no disputing the grounds for this belief; the geological evidence is all that could be desired for proof of a recent origin of the caves themselves. But I must beg leave to dissent from the conclusions which have been drawn from this proof, as to the recent origin of the blind animals. Conditions requisite to the development of eyeless animals are present in most parts of the United States. It seems only required that a species have no use for eyes, irrespective of the presence of light, and the eyes become reduced. Animals which burrow in the soil everywhere show a tendency to loss of the organs of vision. The moles, the worm-snakes (Carphophis), and *Cambarus bartoni* are familiar examples. Parasitic species lose their eyes, not in all cases because of a life in darkness, but because as parasites no eyes are needed. Numerous burrowing insects with poorly-developed eyes are known to occur over wide extents of territory. Beetles which live almost as exclusively in the dark as Adelops and Anophthalmus are not at all rare. Quite a list of non-cavernicolous blind beetles is known. It is to species such as these, already fitted for life in caves, that we should look, it seems to me, as representing the ancestors of cave species; certainly not to ordinary species with well-developed eyes. The originals of the cave species of Kentucky were probably already adjusted to a life in the earth before the caves were formed, and it seems probable from some facts mentioned below that they were not very different in character from the animals now living in the caves. I cannot believe that there has been anything more than a gradual assembling in the caves of animals adapted to a life in such channels. In this view of the matter the transformation of eyed into eyeless species appears to have been much less sudden and recent than has been supposed.

To take a definite example: There appears to be no imperative reason for assuming that the blind crustacean, *Cæcidotea* (*Asellus*) *stygia*, originated in Mammoth Cave. It was first discovered in caves it is true, but occurs widely distributed in the upper Mississippi Valley, is found throughout Kentucky, and is known to occur as far east as Pennsylvania. It is throughout its range a creature of underground streams, and is nowhere more common than on the prairies of Illinois (the last place in the country in which one would expect to find a cave), where it may be collected literally by the hundreds at the mouths of tile drains and in springs. In Kentucky, also, it is not more abundant in the cave region than elsewhere, being very frequently common under rocks in springs and in streams flowing from them, even during its breeding season. It is only natural that such a crustacean should have found itself at home in Mammoth Cave when this cavern was ready for its reception.

The blind fishes, again, are not by any means confined to the caves, but are widely distributed in underground waters throughout the country. *Amblyopsis spelæus* occurs in Indiana, Kentucky, and probably also in Missouri and farther south. *Typhlichthys subterraneus* occurs in Missouri, Kentucky, Tennessee, and Alabama. *Chologaster agassizii* occurs in Kentucky and Tennessee. *C. papilliferus* occurs in a spring in southern Illinois. I have had the pleasure of taking this species, and can say that the spring is evidently the outlet of an underground stream, and sends away a narrow but vigorous rill at all times of the year. *C. cornutus* I have taken, with the help of my friend, Professor B. P. Colton, in North and South Carolina, and can speak positively as to the situation in which it occurs. Like its relatives, it is a fish of underground streams, and makes its appearance at times at their mouths. Still another species appears, according to Dr. Packard, to have been observed in California. Here are widely scattered fishes with the family characters of Amblyopsis, and so probably closely resembling the eyed ancestors of the latter. They illustrate my point that there were in existence species possessing at least some of the characters of the Mammoth Cave forms when the caves became habitable; for it will hardly be supposed that all of these fishes originated in the caves of Kentucky and have become scattered since the glacial period. They illustrate, also, the point that hundreds of generations of a species may exist under the same conditions of environment as Amblyopsis and Typhlichthys, and yet not lose their eyes. Why then should these latter have had their eyes all but obliterated in the course of a few generations?

The distribution in this country of blind beetles of the genus Anophthalmus might at first thought appear to favor the idea that Mammoth Cave is a centre from which our species have been disseminated towards the East. Of our eight described species four (possibly five with *A. audax*) live in the Mammoth Cave region. Two others occur in Wyandotte Cave, only a short distance away. The single species not thus far recorded from these caves is *A. pusio* of Virginia and eastern Kentucky. It is to be remembered, however, that the large caves of Kentucky and Indiana have been much more thoroughly explored for cave animals than those of other parts of the country, and that their size and accessibility to Man have had much to do with the frequency with which they have been visited by collectors. They are simply portions of the haunts of the subterranean species which are opened up to us. One of the blind species (*Anophthalmus tenuis*) of Wyandotte Cave has now been found in Luray Cave, Virginia, a fact which gives us reason for believing that the Mammoth Cave species are more widely distributed than our present knowledge indicates. The large number of species (64) occurring in Europe points to that continent as the habitat from which all species of the genus have spread. If we accept this view of the origin of the genus then, whether the American species were introduced into this country before or after the Champlain period, it follows that our species have been but little modified by residence in Mammoth Cave, for if they had been we should find them departing more widely than they do from their European allies. They are in fact very closely related to European species. If we transfer the question of the sudden appearance of Anophthalmus to Europe, and claim still that the species are of post-glacial origin, that the eyes were lost suddenly after the Champlain period, we are met with the difficulty that here there is a gradation in both the habits and structure of the species which shows that the change may be and probably always has been gradual; for there are in existence species which live under rocks and have rudiments of external eyes.

Another aspect of this question of a sudden transformation of the species has recently been brought to my attention by some observations I have been making on the habits of these beetles, and particularly on a new species of Anophthalmus, of which a description is appended. Isolation in caves has been urged as an important factor in the development of those peculiarities by which cave animals are marked. It is assumed that the cave species are completely shut off from all relations with their out-of-door allies at an early stage in their phylogenic history. Nothing, it seems to me, can be farther from the truth. They are not even now isolated by anything except their inability to look out for themselves in the presence of their eyed enemies. *Cæcidotea stygia* is often found associated with *Asellus communis*, the eyed species from which it is supposed to have been derived. The cave cricket, *Hadenœcus subterraneus*, while occurring in the depths of caves, has always in my experience been found most abundant at the openings, where the twilight prevailing probably does not prevent the use of its well-developed eyes. It is frequently associated in such situations with its near relatives of the genus Ceuthophilus. Nor are the blind beetles confined to parts of caves in which total darkness prevails. Probably *Anophthalmus tellkampfi* is as completely adapted to a life in darkness as any of our species, and I have not yet found this species in the light; but I have found it abundant in a cave where

the rumbling of vehicles (not more than twenty feet away) passing on a road overhead could be distinctly heard. In all probability the beetles of this cave penetrate much nearer the surface than this. Some of the other species are common under rocks and wood in the shade of overhanging cliffs at the mouths of caves where they are associated with the Carabidæ commonly found in such places. The isolation, such as it is, is largely voluntary on the part of the insects, and I can see nothing in the surroundings or habits which would indicate that they have ever been more completely isolated than they are now. I believe, on the contrary, that they are more completely isolated now, from specialization, than ever before.

In short, a reconnaissance of the zoölogy of Kentucky, which the writer has had an opportunity to make during the past two years, satisfies him that the evolution of the structures which characterize our cave species is to be considered apart from the question as to the age of Mammoth Cave, and that the origin of our aquatic cave fauna is in some respects a separate question from that touching the origin of the insect fauna.

Of these matters I hope to have something further to present in the future. Of the insects I may say now that there appears to have been after the Champlain period a migration towards Mammoth Cave of cave insects from the south and east, where the continent had not been so greatly affected by changes of level as was the Mississippi valley. Some observations in my possession tend to show that cave species are now abundant in the vicinity of the mountains of Eastern Kentucky. In fact much of the eastern end of the State appears to be adapted to an extensive subterranean fauna It was a source of wonder to me during the first few months of my residence at Lexington how the rainfall disappeared so rapidly. A precipitation, which in central Illinois would have left its traces in muddy roads and swollen streams for weeks, disappears here in the course of forty-eight hours, having been swallowed up by a network of fissures in the underlying limestone and hurried down to the Kentucky River. These fissures are co-extensive with the Trenton limestone of this locality, and constitute the natural drainage system of the blue grass region of Kentucky. The wonder is not where the rainfall goes, but that any at all should remain at the surface. It early occurred to me that one might find cave animals in these fissures could he but get access to them. This can be done in some cases in quarries, and I can say as the result of preliminary exploration that some cave insects do occur here, and that at least one blind beetle is as abundant as it well could be. On a single visit to one of these opened channels I have, with the aid of a pupil, taken over one hundred specimens of the new species here described. It is without trace of external organs of vision, but like the earthworms possesses the power of recognizing light, a power which is evidently of some importance to it. It occurs in channels seemingly wherever there is food and moisture, and may be collected in the dim light near the openings. For some time I have kept forty individuals of this little beetle in my cellar where it appears to be perfectly at home, although during the day the light is never wholly excluded from its quarters. It wanders about freely, but may be sent scampering to cover by a flash of strong light. The food evidently consists of dead animal matter, such as insects and small mammals which are carried into fissures by freshets. This supply must be very great, though perhaps somewhat irregular; but this latter is a feature of the available food supply of many ordinary insects. Dead grasshoppers carried into the fissures are eagerly devoured. Food is evidently discovered by the sense of smell. In three minutes after placing a freshly killed grasshopper on the ground in one of the channels, several beetles were found at work on it. In confinement the beetles collect on such food after the manner of small ants, and eventually leave only the empty crust.

Anophthalmus horni, n. s. Somewhat depressed; smooth and shining; head, thorax, elytra, and abdomen everywhere provided with scant, erect, microscopic pubescence. Head oval; cheeks rounded; dorsal linear impressions rather deep; surface between the impressions very finely transversely rugulose; mentum tooth prominent, bicuspid. Antennæ densely pubescent excepting the thickened basal segment, which is smooth and shining, with a few hairs near its distal extremity. Thorax trapezoidal, larger than the head; sides strongly arcuate in front; sinuate behind; the hind angles acute but not produced; basal impressions deep, separated by a ridge at which the well-marked median linear impression terminates; truncate behind, but with a shallow emargination at each side separated by a wider median one; margin of contracted posterior part a trifle convex before the posterior angles. Elytra oblong oval, widest a little in front of the middle, truncate in front with the rounded humeri rather prominent; humeral margin obsoletely serrulate under a high magnifying power; striæ very evident next the suture, becoming obscure next the outer margin, obsoletely punctured, the third and fourth broken near the middle by a dorsal puncture, the sutural stria recurved at the posterior extremity of the elytron, joining the third; four rather strong punctures within each humeral margin, the second of which gives rise to one of the long setæ. Color pale fulvous, fading on posterior part of elytra to yellowish white, or cream color; curved impressions of head, edge of prothorax behind and at sides, rims about coxæ, etc., darker; length of body 3.67–4 millimeters; antennæ, 2–2.28 millimeters; length of head, 0.64 millimeter; width of head, 0.60 millimeter; length of thorax, 0.72 millimeter; width of thorax, 0.80 millimeter; width of thorax at base, 0.66 millimeter.

The species is closely related to *A. pusio*, Horn, from the Carter caves of eastern Kentucky, agreeing in size, in the absence of evident serrulation at the humeral margins of the elytra, and in the deep basal impressions of the prothorax. It differs in the size and shape of the prothorax, *A. pusio* having a very small prothorax, "not as long as the head and scarcely larger," whereas in this beetle the prothorax is distinctly larger than the head. The prothorax in *A. pusio* is as wide as long, and contracts in width somewhat gradually from the front, while in the new species this division of the body is broadly rounded at the sides, contracting rather abruptly behind. *A. pusio* is said to have pubescence only at the bases of the elytra. In this species the pubescence is rather scant, but is present on all the surfaces. The new species was discovered within the corporate limits of Lexington in the spring of 1890. It is named in honor of Dr. G. H. Horn of Philadelphia, who has contributed much towards an accurate knowledge of our species of Anophthalmus.

State College of Kentucky, Lexington, Oct. 8.

THE BOTANICAL LIBRARY OF A STATION BOTANIST.

BY A. S. HITCHCOCK.

PROBABLY the most essential part of the special equipment of a botanist to an experiment station is his working library. At least a part of the work of a station should be original investigation. In order that the results of his investigation should be an addition to the sum total of the world's knowledge, it is obviously desirable that the investigator should know all that has been published on the subject up to the time he presents his own results to the public. In the scientific world results are said to be known when they are put on record; that is, when they are published. If all the results of botanical investigation were published in one periodical, it would be an easy matter to hunt up the literature on a given subject. If all the results were to be found in botanical periodicals in the English, French, or German language, our work would be less easy, but still not difficult. But, lo! where must we look for our information? In botanical periodicals in all languages. I doubt if there be a station botanist in this country who can readily read all the botanical literature published in Europe. This statement will probably hold good if we exclude the Hungarian, Polish, and Russian; and most of us are confined to French, German, Latin, and possibly Italian. But this is not the worst; we must look through the proceedings of a multitude of scientific societies, prominent ones whose proceedings are readily accessible in the larger libraries, others more or less local and little known. But even this is not the worst; we find botanical literature in periodicals or proceedings devoted to general science, or even to miscellaneous matters. Sometimes it is valuable-

away in a seed catalogue. a weekly agricultural paper, or even a college monthly. Fortunately there is a growing tendency to have articles reprinted and distributed more or less freely among contemporaries. In addition to these various channels of publication, we have the thousands of books, pamphlets, and sheets devoted more or less to botanical subjects.

It is obviously impossible for a station botanist to have ready access to even a tenth-part of the accumulated literature. It is only at the larger public institutions that an attempt toward completeness is made.

But in botany, as in other sciences, the period has long since been reached when classification of its literature was necessary. Thus with the proper aids it is possible for every botanist to become fairly familiar with the literature on any subject.

Probably there are as many opinions as there are station botanists as to the selection to be made of these aids, and it is the object of this paper to give one opinion out of the many.

First, as to the periodicals; assuming, as is generally the case, that the funds for library purposes are quite limited. Most of us take from our own country at least the *Botanical Gazette* and the *Bulletin of the Torrey Botanical Club*. The latter is especially useful for its "Index to Recent Literature Relating to American Botany."

Of foreign periodicals I would mention the *Botanisches Centralblatt*, for its "Referate," under which heading are given classified reviews of important articles, and for its "Neue Litteratur," which is an index, and a very complete one, to the current literature in all languages; the *Revue Générale de Botanique*, for its excellent reviews of the work done in various departments of botany during a given period; and the *Societatum Litterae*, giving monthly a classified list of articles published in the proceedings of scientific societies.

All will agree that by far the most important work is *Just's Botanischer Jahresbericht*. This gives an abstract, long or short, according to importance, of all the botanical articles published during the year. It is well indexed and classified.

Most of the station botanists are working more or less in special lines. The above-mentioned works will enable him to get at least the titles, and often an abstract of the contents, of nearly all the articles that have been published on his special subject. The most difficult period to cover is the last few months. *Just's Jahresbericht* is about two years behind, and the *Centralblatt* usually at least a few months.

Having at hand the titles and authors on a given subject, it is often desirable, or even necessary, to obtain the articles. Books, pamphlets, and reprints can usually be picked up through dealers in second-hand books. Separate numbers of the current periodicals and proceedings can usually be obtained. There remain such articles as are to be found only in the back numbers of serials. These are often very important and difficult to obtain. It is out of the question to think of purchasing these expensive works, for station libraries have too limited an income for this purpose. A good way is to be on the lookout for separate volumes containing the articles desired. But this requires some knowledge of the serials.

Three important works for this purpose and for botanical bibliography in general are Pritzel's "Thesaurus Literaturae Botanicae," Bolton's "Catalogue of Scientific Periodicals," and Scudder's "Catalogue of Scientific Serials."

After one obtains all the articles possible in this way, there will still be many that are unattainable. For these one must consult a large library. Short articles can then be copied, and notes can be taken of long ones. Photography will doubtless, in the future, play an important part in copying rare articles and plates. This can be done at a comparatively small expenditure of time and money, and has the immense advantage of being certainly correct.

I have said nothing about the selection of general works of reference and other books, as this depends so much on individual opinion and the line of work followed; but the above-mentioned aids to the botanist seem to me to be a necessary part of the equipment of every experiment station.

Agricultural College Experiment Station, Manhattan, Kansas.

FORENSIC MICROSCOPY.

BY L. A. HARDING, B.SC., PH.D.

FORENSIC Microscopy, like Forensic Medicine, has a close connection to law; it also deals with cases which are closely interwoven with the administration of justice, and with questions that involve the civil rights and social duties of individuals, the detection of poisons as well as the treatments of the recovery of poison from the poisoned. More and more in the history of the criminal courts is the demand occasioned for the application of the microscope, and microscopical toxicology. Although of late a certain line of medico-legal research has been obliged to combat with the works of the undertaker, who, when preserving the bodies of the dead, employs preservative compounds, largely composed of arsenical and mercurial compounds, while there is no question as to their preservative properties, yet the question arises, Is it good policy, is it for the good of the community at large, to employ embalming fluids composed of such poisonous substances? Criminals may easily hide their heinous crimes by having their victims embalmed, and who is there to tell which of the poisons was administered by the hand of the coward who did not dare to do his work before the world and openly, who for pecuniary or other reasons sought this road to remove a good man, nay, perhaps the man least to be spared, and who is there to identify the poison introduced by legitimate (?) means from that introduced with murderous designs? Yet, despite this opposing energy, despite the seemingly unsurmountable difficulties which surround forensic microscopy and toxicology on every side, we are still making progress and demonstrate that "forensic microscopy" is destined to be a branch of science which cannot be ignored, try as the opposers may.

If we measure the future by the work and benefits the microscope has done in the past, it will be seen that a very bright prospect is awaiting us indeed. No instrument yet devised by the ingenuity of man can compare with the microscope in its universal application to research in the broad domain of science, and I will endeavor in a brief way to call attention to a few of its special relations to law.

The direct application of the microscope to law dates back to about 1835, and ever since that time it has made a record for itself in convicting the guilty and protecting the innocent. The expedient taught to us by Albertus in 1226, that the victim's wounds would open afresh in the presence of the slayer, or the custom honored from time immemorial of watching the effect upon the suspected criminal as he touched the dead body of his supposed victim, we no longer are obliged to resort to. In the early age of forensic microscopy, its application was simply confined to a few questions of criminal law; but the more it attained perfectness in lenses, the excellent means of determining minute measurements, the adaptation of the spectroscope, and numerous valuable mechanical appliances, it has claimed so much attention in civil and criminal law that its usefulness cannot be denied. Although the microscope has played a very important part for a number of years in noted criminal and civil cases, its proper relation to law seems to be little understood. It is true that many underrate its value, and throw aside all testimony attained through its use as worthless, while others again largely overrate its powers. It is a well-known fact, though an unfortunate existing condition of affairs, that persons are permitted to give expert testimony in branches where they have but little more knowledge than the court before whom they testify. It is largely from this cause that so much discredit has been thrown upon the whole field of expert testimony, especially in this country. This condition of fact does not alone relate to forensic microscopy, but it has invaded all branches of expert testimony.

When, however, persons expert in the use of the microscope are called upon to give testimony, there ought not to be any disagreement as to the result of the examination they may make; as, for instance, if they examine a stain, and blood corpuscles are found by one, it should be verified by the other; and, if measurements of these corpuscles are made, their measures should correspond without a doubt. There should be no difference on such matters of fact, though this is not meant to imply that they should

not honestly differ as to how the blood came there. The microscope will tell with true and unerring certainty whether the adhering substance on a weapon is human or animal hair, or whether what is thought to be hair is not cotton, silk, or wool fibre. It is a well-known fact that portions of brain-substance adhering to weapons which have caused the fracture of the skull and laceration of the brain can only be recognized by the microscope. While, when the substance is fresh it cannot easily be mistaken, it is quite different when it becomes dry; it will then assume a gray or brown color, and become quite horny. In this state no physical appearance can tell what it is, the naked eye is at a loss to recognize its source. Quite different with the microscope; it will tell you. Moisten the substance, and you will see its color become whiter and its consistence quite soapy. Now if you soften the mass in a solution of common salt, I will show you nerve-cells or nerve-fibres; though so small, being only $\frac{1}{1000}$ of an inch or less in diameter, you shall see them plain and distinct. Likewise, hair adhering to clubs or weapons of any kind can be recognized as to its source, whether it has been torn out by force or not. If by force, we plainly see the tubular sheath of the hair, with the hair issuing from it; the color is distinguishable, the size, and whether they are cut at both ends or pointed at one, whether the bulb or sheath in which it grows is still attached to them, etc. It may not be amiss to state that hair from lower animals differs in a great many particulars from that of man; the hairs of animals, generally speaking, are coarser, thicker, shorter, and less transparent. The ones which bear a close resemblance to that of man are the spaniels and sky terriers whose hair is long and silky, though the linar markings on the cortial portions are not so numerous and fine. It is a deplorable fact that very little of value has been written upon the subject of hair in its medicolegal relation. While it cannot be denied that all the works on forensic medicine mention this subject, yet they are based upon very little original research; they are mainly copied one from another. We shall say more on this subject at a later date; we are willing to admit that it may not at all times be perfectly discernible as to the source of the hair, yet, when taken in conjunction with other evidence, doubt may be removed and positive evidence established.

It is understood, of course, that the examination of supposed weapons should be conducted with the greatest care, and notes taken, full notes in fact of all the detail and every process in the operation; especially spots and marks which can have any possible bearing upon the case under question should be carefully noted.

In the broad domain of chemistry and toxicology the microscope is a very important factor for the identification and verification of many ordinary tests, which are made to determine the composition of solids and liquids. Not many years ago, death from poison was surrounded by dread and fear scarcely comprehensible at the present day. Tradition informs us that persons suspected of having committed murder by poisoning were broiled alive in England, and in France burned at the stake, and in the various other countries tortured in the most inhuman manner. It is now, however, generally conceded that, with modern methods introduced for the detection of poison, the fear of discovery has been rendered greater than the dread of punishment. The greatest advance in legal chemistry was through the achievements of Bunsen and others; quantities so minute as to be out of reach of all other known methods of analysis, we are enabled to identify with unerring certainty. Many poisons, such as strychnine, arsenic, morphine, etc., will crystallize with certain reagents into characteristic forms, which are peculiar to themselves.

Of late considerable attention has been paid to the microscopical examination of hand-writings. While perhaps the microscope cannot be considered an aid in forming an opinion as to the real author of a given specimen, yet its value for the detection of alteration and changes made in the original cannot be underrated. It is impossible to make an erasure of any written or printed lines and hide them from detection by the microscope; the most skilful forger cannot restore the slightest derangement of the fibres on the finished surface of the paper.

Equipped with the modern improvements and possessing the requisite skill, the progressive microscopist may be said to be a true friend of the curious, in the full meaning of this expression. It is true that sometimes our most exhaustive means of industry and research are only rewarded by negative results; yet it cannot be denied that in the majority of cases we reap the reward of diligence and industry by seeing our work change the whole theory of a plea in civil and criminal action, becoming a terror to the guilty and joy to the innocent.

THE tenth congress of the American Ornithologists' Union will convene in Washington, D. C., on Tuesday, November 15, 1892, at eleven o'clock, A.M. The meetings will be held at the U. S. National Museum. The reading of papers will form a prominent feature of the meetings. Associate as well as active members are earnestly requested to contribute, and to notify the the secretary before November 12 as to the titles of their communications and the length of time required for their presentation, so that a programme for each day may be prepared.

— Among the articles of the November number of *The Forum* is one on "The Library of the United States" by Mr. Ainsworth R. Spofford, Librarian of Congress, who explains the rank that this great library will take among the great libraries of the world. In the series of articles on Municipal Government there appear two contributions in the November number: 1, by the Rt. Hon. Joseph Chamberlain, who compares the Government of Birmingham, England, with the Government of Boston, and tries to ascertain why Boston's government costs five times as much as Birmingham's, they being cities of about the same size; and 2, by Mr. Charles Francis Adams, who points out lessons from the municipal experience of Quincy, Massachusetts. Professor Edward S. Holden, Director of Lick Observatory, tells what we really know about Mars. In the series of articles giving the results of his investigations into our public-school system, contributed by Dr. J. M. Rice, the November number contains his study of the schools in Buffalo and Cincinnati.

— Mr. O. P. Hay has furnished for recent "Proceedings of the National Museum" three interesting biological papers. The first is entitled "On the Ejection of Blood from the Eyes of Horned Toads," and establishes beyond question the fact that under certain conditions about the time of moulting *Phrynosoma coronatum* ejects from the eye a small quantity of blood. Mr. Hay records personal observations on the toads, and also quotes the experiences of others. Professor L. M. Underwood furnishes the following account: "In 1885 a student of mine received a specimen of horned toad from California. In examining the animal I took occasion to turn him on his back, using a lead pencil for the purpose. The animal resented this treatment, and showed considerable anger, opening his mouth and puffing up his body. On being irritated still more, he grew more and more enraged, until finally blood spurted from just above his eye to a distance at least a foot from the animal, as several spots struck my arm considerably above the wrist. After spurting the blood the animal became limp and collapsed, and remained in a stupor for some time; and when handled behaved as if dead. After a time, possibly not over five or six minutes, certainly not over ten, the animal revived and commenced to run about the table. Wishing to know if he would repeat the operation, I commenced to irritate him again in the same manner. After becoming enraged again, the animal soon went through the same process, ejecting blood from the same eye as before. He then fell into a similar stupor and remained about the same length of time, after which he revived. No amount of irritation could produce a third discharge, although the animal showed some anger." Mr. Hay also records "Some Observations on the Turtles of the Genus Malaclemys," and presents a number of interesting facts concerning "The Breeding Habits, Eggs, and Young of Certain Snakes." No. 905 of the Museum "Proceedings" consists of a valuable paper by Mr. L. O. Howard on "The Insects of the Sub-Family Encyrtinæ with Branched Antennæ." Three new genera (*Pentacnemus, Tetracladia, Calocerinus*) and species are described, five species being figured.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

BOGDANOV ON THE PRIMITIVE RUSSIANS.

BY JOHN BEDDOE, LL.D., F.R.S.

THE Anthropological Congress lately held at Moscow, however much its attractions and its attendance may have been diminished by the cholera scare, has at least produced one very notable and interesting paper — that by the veteran Professor Anatole Bogdanov, entitled "Quelle est la race la plus ancienne de la Russie centrale?" In it Bogdanov recalls the fact that twenty-five years have elapsed since he published his first researches into the subject on which he now delivers a fairly matured opinion. During a great part of the interval he has been laboring in this field and collecting material, not from the centre only, but from all parts of Russia, though at times he seems to have abandoned the effort for a while in a kind of despair.

His earlier researches led him to form the opinion that the kurgans (tumuli) of central Russia, believed to date from the ninth up to even the fifteenth century, contained the remains of two races, one dolichocephalic, tall and strongly made, with light-brown hair, the other smaller, with short, broad head and dark-brown hair. The former he found preponderated in the earlier kurgans, and in the south-western part of the central provinces, the latter at later dates and more to the north-east. In spite of the mode of location, but in accordance with the apparent dates, those who considered these facts mostly agreed that the dolichocephals were of Finnish kindred, Merians probably, and that the shorter heads belonged to the Slavs who invaded and incorporated them.

Later discoveries and the products of a wider field do not, in Bogdanov's opinion, confirm this view. These long skulls, which, though the occiput projects considerably, have usually well-developed frontal regions, and are by no means of low type, are found to prevail in the older interments throughout the west and south as well as the centre of Russia, while short heads abound in the north and east, in the ancient kurgans of the Uralian region and in those of the Bashkir territory. Bogdanov inclines to the opinion of Poesche, that the Slavs "descended in reality from a dolichocephalic source." And, seeing that the modern Slavs are on the whole moderately brachycephalic, he thinks that the prevailing form has somewhat changed through contact and crossing with races having broader heads (meaning probably the Mongoloid races which lie and have lain to the east of them), but also owing to the operation of other (external) causes. "With the progress of civilization," he says, "begins another series of influences, which has played a great part in the history of peoples, and may play a still greater one in the future, because the conditions of civilization bring about necessarily in the course of time an increase of brachycephalism. . . . Dolichocephalism declines more and more in Europe, and the heads become larger and finer."

Thus does Bogdanov range himself on the side of the short heads in the curious controversy which is arising in Europe as to the relative merits of the two leading forms of cranium, and to which Obedenare, Laponge, and Von Ammon have contributed both facts and opinions. I recollect asking Professor Rokitansky, five and thirty years ago, whether the Czechs were not brachycephalic. Rokitansky was himself a Bohemian, and he was evidently nettled by a question which he thought touched upon a weak point in his fellow-countrymen. "Ah! well!" he said, "they are a very clever people for all that." On the other hand, Messrs. Jacobs and Spielmann, in their recent paper on the physical characters of British Jews, almost apologized for the long-headedness (in a physical sense) of the Sephardim, as a mark of inferiority! Since Topinard claimed the Aryan language as the original property of the short-headed Kelto-Slavo-Galcha family, their congeners have taken heart, and threaten to push us long-heads from our stools of conceit.

Whence came these aboriginal dolichocephals of Russia? "Not from Asia or the Caucasus," says Bogdanov. "It is more likely that they came from the Danube, where we find at present dolichocephaly predominant [in Bulgaria]. They probably followed the Dnieper into White Russia, thence to Novgorod and into Sweden. This was the northward stream. About the same time there was probably an eastward current through Minsk to Yaroslav and Moscow, and a western one by Galicia, the Vistula, and the Danube."

ON "TYPE-SPECIMENS" AND "TYPE-FIGURES" IN ENTOMOLOGY.

BY W. F. KIRBY, LONDON, ENG.

A "TYPE SPECIMEN" is the specimen of an insect from which the original describer drew up the first description of a species; and it is often of great importance to settle disputed points of nomenclature, where any doubt exists respecting the actual identification of a species; for if we are certain that we have the original specimen before us, no further dispute is possible. A "type-figure" is the figure quoted by the original describer as illustrating his species, or is a figure supposed to represent the species published by a later author.

This appears plain enough; but in practice it is not always satisfactory. The specimens described by the older authors, such as Linné and Fabricius, are not always in existence, and in other cases it is not always certain that the specimens in various old collections supposed to represent the types of these authors are actually the real specimens which they described. Again, Linné frequently quoted several figures of different species as illustrating one of his species; and, in several other cases, he seems to have described quite different species in his successive works. Under these circumstances it does not follow that a specimen, even if ticketed by Linné himself, is necessarily the species which he originally described. Some of the later authors, too, such as Müller and Hontheim, have figured insects as species of Linné, and applied wrong Linnean names to their figures in the most reckless manner.

In the case of Fabricius, we already meet with far more careful and conscientious work; and when Fabricius describes an insect from a known locality, there is often very little doubt about what he really intended. But his names, too, were frequently misapplied by his contemporaries; and it is only lately that several insects which he described from India, but which his contemporaries mistook to refer to European species more or less resembling them, have been correctly identified. Gross errors, too, have been committed by certain recent authors who have found specimens of insects supposed to have been named by Fabricius in old collections, and have jumped to the conclusion that they were his original types, though neither the locality nor the description may have applied to them at all. This does not apply to collections indubitably referred to by Fabricius, such as the Banksian and Hunterian, which may usually be regarded as authoritative.

Again, some authors have cared more for the condition of their specimens than for scientific accuracy, and may in some cases have actually got rid of their own types and replaced them with better specimens, possibly of a different species more or less re-

sembling the real one; this, apart from errors or transposition of labels, to which accidents all collections are more or less liable, in proportion to their age.

While, therefore, fully admitting the great value of a type, or type-figure, it is necessary to ascertain that it is really the specimen or represents the specimen originally described. If it contradicts the original description in any important respect, and especially if it is an insect known to be from a different locality to that assigned to it by the original describer, it is more than probable that it is not the original type at all, and is worse than misleading. Errors of locality are always possible; but much will depend on the author. Donovan, for instance, was extremely careless about localities, but, as he figured all his species, this matters less; on the other hand, Fabricius was far more careful than later authorities have given him credit for; and an error of this kind in his work was quite exceptional.

THE CONVEX PROFILE OF BAD-LAND DIVIDES.

BY W. M. DAVIS, HARVARD COLLEGE, CAMBRIDGE, MASS.

IN Mr. Gilbert's analysis of land sculpture, constituting chapter V. of his "Geology of the Henry Mountains," he explains why the surface of an eroded region possesses slopes that are concave upwards and steepest near the divides, and shows that it is for the reasons there stated that mountains — that is, mature and well-sculptured mountains, such as are of ordinary occurrence — are steepest at their crests (p. 116). The *arêtes* of the Alps illustrate this perfectly. Gilbert calls this generalization the "law of divides."

But in discussing the forms assumed by eroded bad-lands, or arid regions of weak structure with insignificant variety of texture, he finds an exception to the law of divides. The two lateral concave slopes of a bad-land ridge do not unite upwards at an angle, forming a sharp divide, but are joined in a curve that is convex instead of concave upwards. "Thus in the sculpture of the bad lands there is revealed an exception to the law of divides,— an exception which cannot be referred to accidents of structure, and which is as persistent in its recurrence as are the features which conform to the law,—an exception which in some unexplained way is part of the law. Our analysis of the agencies and conditions of erosion, on the one hand, has led to the conclusion that (where structure does not prevent) the declivities of a continuous drainage-slope increase as the quantities of water flowing over them decrease; and that they are great in proportion as they are near divides. Our observation, on the other hand, shows that the declivities increase as the quantities of water diminish, up to a certain point where the quantity is very small, and then decrease; and that declivities are great in proportion as they are near divides, unless they are *very* near divides. Evidently some factor has been overlooked in the analysis,— a factor which in the main is less important than the flow of water, but which asserts its existence at those points where the flow of water is exceedingly small, and is there supreme" (pp. 122, 123).

It has for some time seemed to me that the overlooked factor is the creeping of the surface soil; and, as I have not seen mention of this process as bearing on the form of the crest-lines of divides, a brief note on the subject is here offered.

The superficial parts of rock-masses are slowly reduced to rock-waste or soil by the various processes included under the term, *weathering*. Unconsolidated materials are in the same way reduced to finer texture near their surface. The loose and often fine material thus provided at the surface is carried away by various processes, of which the chief are moving water, moving air, and occasionally moving ice; but there is an additional process of importance, involving dilatation and contraction of the soil, and in consequence of which not only the loose particles on the surface are transported, but a considerable thickness of loose material is caused to creep slowly down-hill.

Dilatation is caused by increase of temperature, by increase of moisture, and by freezing. Vegetable growth may probably be added to this list. The movements are minute and slow. They are directed outwards, about normally to the surface. Contraction follows dilatation, when the soil cools or dries, or when its frost melts. The movement of the parts is then not inward at a normal to the surface, but vertically downwards, or even downwards along the slope. As the two motions do not counterbalance each other, a slow down-hill resultant remains. This is greatest near the surface, where the dilatations and contractions are greatest; but it does not cease even at a depth of several feet, perhaps of many feet. Hence the down-hill dragging of old-weathered rock often well shown in fresh railroad cuttings in non-glaciated regions. I presume all this is familiar to most readers; although from the frequent inquiry concerning the means by which valleys are widened it is evident that the creeping process is not so generally borne in mind as that by which running water washes loose material down-hill.

The form assumed by the surface of the land depends largely on the ratio between the processes of washing and creeping. Wherever the concentration of drainage makes transportation by streams effective, the loose material is so generally carried away (except on flood-plains) that the action of creeping is relatively insignificant. But on divides, where drainage is not concentrated but dispersed, the ratio of creeping to washing is large, even though the value of creeping is still small. This is especially the case in regions of loose texture and of moderate rainfall; that is, in typical bad-lands, where the supply of loose surface-material ready to creep is large, and where the loose material is slowly taken away by washing. On the divides of such regions, the surface form is controlled by the creeping process. The sharp-edged divides, that should certainly appear if washing alone were in action, are nicely rounded off by the dilatations and contractions of the soil along the ridge-line. The result thus determined by the slow outward and downward movements of the particles might be imitated in a short time by a succession of light earthquake shocks.

Mr. Gilbert has himself given several beautiful illustrations of the close dependence of sharp or rounded divides on rainfall; structure remaining constant. If the rainfall should increase in bad-land regions, would not all their divides become sharper; and if the rainfall were continuous, so as to carry away every loose particle as soon as it is loosened, would not the divides assume the sharp ridge-line expected from Mr. Gilbert's analysis but not found in the actual arid bad-land climate? In the eastern and well-watered part of our country, I have often seen clay-banks much more sharply cut than the equally barren surface of the western bad lands; but even on clay-banks, the minute divides between the innumerable little valleys are not knife-edge sharp; they are rounded when closely looked at. Perhaps they are sharper in wet weather and duller in dry spells.

If rainfall remain constant and structure vary, then the harder the structure, the less the supply of soil for creeping and the sharper the divides; the weaker the structure, the more plentiful the supply of soil for creeping and the duller the divides. Numerous examples of this variation might be given.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Some Remarks on the Botanic Trinomial.

AN article in *Science* for September 16, signed C. H. Tyler Townsend, contains certain statements which cannot be passed, it seems to me, without some few words of discussion. It is quite evident that this article loses sight entirely of the main purpose of a biological name, and seems to imply that the name of a thing has to do with justice, right, etc. For example, I find therein the following expressions: "In no case can the name of the original erector and describer of a genus be separated therefrom without gross injustice." "There is no necessity whatever for shedding glory upon the one who has made the transfer. . . . He has no right whatever to the species." These words, "injustice," "right," belong to the field of Ethics, not that of Taxonomy.

I shall try to consider the botanic trinomial, not from the ethical point of view as Mr. Townsend seems to have done, but from the taxonomic strictly.

We find it convenient to give a name to a plant simply because the use of the name serves to call up an aggregate of characteristics when we wish, without the necessity of detailing those characteristics. The whole matter is one of convenience simply, and a name means nothing more than this.

It has been pretty universally agreed that it is more convenient to have a binomial name than a monomial one, for by this means we are enabled easily to group our plants, the first name serving to call to mind the aggregate of characteristics of the group (genus), possessed often by many sub-groups (species), and the second those characteristics possessed to a greater or less extent by the individuals that go to make up the sub-group.

So far this seems to be reasonable enough, and, following the same lines, should we choose to add a third name to our binomial, making it a trinomial, we should naturally do so for the purpose of segregating these sub-groups into still smaller ones (varieties). On this line the addition of terms might rationally be continued to the extent that the facts of observation would warrant.

But we find in the *de facto* botanic trinomial a mixture of two taxonomic principles, instead of the rational following out of the single line indicated by adding to the monomial the second term. Usually the third term is added as a compromise with existing fact, simply to avoid the possibility of having two homonomic binomials, and consists of the name of the person who first published the binomial. It is evident that this addition of such a third term serves a purpose only in comparatively rare cases; in the vast majority, were it not for the fear that some future comer would see fit to use the same binomial to designate another plant, it would be, as a name, useless. But at present the addition of the author's name is essentially a part of the naming of the plant.

It is this third name, and comparatively useless one, that is the cause of much of the trouble of the botanic taxonomists. Many seem to feel that this serving as a compromising tailpiece, the necessity for which it is confessedly the aim of the botanic world to do away with altogether, is an honor. And for this reason there is strife in a large class of cases as to the third name to be added to the binomial. For consider the following specific case. Hooker and Arnott notice a plant, which, in their judgment, is a member of the large group of plants that has been called Malva. They therefore give it the binomial name *Malva malachroides*, and first publish the characteristics which that name is to call up. Afterward Gray considers that the plant cannot belong to the group called Malva, and so gives the same plant the name *Sidalcea malachroides*. More recently Greene finds that the plant can be neither a Malva nor a Sidalcea, and calls it *Hesperalcea malachroides*.

Now suppose we have an individual of this group and wish to give it the most convenient name. For the name of the main group undeniably it matters not which of the three names we choose; if we have had the opportunity of studying the plant carefully our choice will be determined by the observed facts and our own judgment. Personally, in the present case, I chose to call the plant Hesperalcea. For the second name there is no choice, the three authors having given it the same. (Had there been a diversity of names here, the name first given the plant would have been chosen, not because this is "just," or "right," but because by this artificial rule we obtain a permanent factor in the name, without fossilizing individual opinion at all regarding the affinities of the plant.)

We now come to the third name, only added, remember, from the fear that some one has called or will call some different plant Hesperalcea malachroides. Here custom is divided, and many would write *H. malachroides, H. and A.*, and others *H. malachroides, Greene.* It is for us now to determine which of these names is the most convenient.[1] The person to whom we wish to communicate the idea, H. malachroides, upon seeing the trinomial H. malachroides, H. and A., naturally turns to the works of H. and A. to find the summing up of the characters of the plant. But here he is met with an insurmountable difficulty. He can find no trace of it. Let him look for *malachroides*, perchance Mr. Townsend would say. But it is easily possible that H. and A. have described five species by the name of *malachroides*. On the other hand, suppose we write H. malachroides, Greene, the person wishing to know of this plant would turn to the works of Greene and there would find the reference to Malva malachroides, H. and A., which would enable him to find the original description of the plant and thus obtain the idea which we wished to convey.

[1] I have not considered the writing of H. malachroides (H. and A.) Greene, as the parenthetical term is no more an essential part of the name than the date of publication or twenty other particulars which might occur in a monograph on the plant.

It seems plain enough then that the third name of this trinomial from the standpoint of convenience should be Greene and not H. and A..

Mr. Townsend disposes of this difficulty in the following words:—

"I would write Metzgeria pubescens schrank, . . . and make no more ado or trouble about it. . . . This signifies always that the authority named described the species originally and originally proposed that name. The founder and date of the genus can be ascertained by referring to any monograph."

It is obvious on a little thought that this paragraph assumes a good deal more than the facts warrant. In the first place there certainly will be no monograph of the species named *pubescens*; and it is very possible that a monograph of the generic name chosen may not exist.

But it is perhaps allowable to look at these two trinomials from a slightly different point of view. Which tells the most truth? H. malachroides, H. and A., implies that H. and A. would now choose, as we have done, the group Hesperalcea for this plant. This we have no right to imply; as a matter of fact they did choose Malva, and this is all we know or should state.

Of course, in all the preceding I have assumed that the purpose of a name is to convey from one person to another the idea of a thing, and on this hypothesis it seems to me that the conclusions arrived at are sound; but I would not wish to be understood as desiring that a name should do no more than this. If it can convey the history of the thing, well and good, as long as by trying to do this it does not entirely defeat its own purpose, as I think I have shown Hesperalcea malachroides, H. and A., would do.

C. MICHENER.

San Francisco, Oct. 7.

Notes on the Saturniidæ, or Emperor and Atlas Moths.

ALTHOUGH the family *Saturniidæ* comprises the largest and some of the handsomest of all the *Lepidoptera*, it is still very imperfectly known. The larvæ are mostly gregarious, and feed on trees. Many of them form cocoons, which are attached to the branches of the trees upon which they live, while others (at least in South Africa) are said to pupate in the ground. I am not certain whether it has yet been ascertained whether this latter habit has been proved to be peculiar to certain species or genera, or whether the same species may form its pupa in different ways, according to circumstances.

There is doubtless a much greater variety of these insects in tropical countries than we are at present aware of. Many of the most remarkable species are only received singly, and often remain unique in our collections for years. Collectors rarely have an opportunity of rearing them from the larvæ, even if they should meet with a brood, and many species probably feed on lofty trees, quite out of reach, while the perfect insects are nocturnal in their habits. Many of the larger, and especially the domesticated species of *Saturniidæ* from which silk is obtained in India, China, and Japan, vary very much, and this is another obstacle to their successful study. Many of these domesticated breeds, and the various wild or semi-domesticated forms allied to them have been simply named, and not described; or perhaps only the food-plants and localities have been indicated. These useless names find their way into our collections and from thence into our lists and papers, and form a wholly unnecessary element

of confusion, which should be eliminated as soon as possible, either by the actual description of the species, or by the rejection of these manuscript names. The mischievous practice of attaching names to insects without describing them has long been abandoned by lepidopterists in every branch of the study except sericiculture. W. F. KIRBY.

London, England, Sept. 25.

Destroying Mosquitoes by Kerosene.

THE reason for the existence of mosquitoes has often been asked. Some means for their destruction has, perhaps, been even more earnestly sought after. The idea that their numbers can be kept down by propagating dragon-flies does not seem to be any longer entertained; and any experiment bearing on some means for their destruction is of interest. In a late number of *Insect Life*, Mr. L. O. Howard publishes a note upon the use of kerosene against them, the substance of which is as follows: On the surface of a pool of water, containing about 60 square feet, he poured four ounces of kerosene. This formed a very thin oily film on the surface of the water. On the 5th of July the pool was teeming with animal life, but for the next ten days that the pool was under observation no living insects were observed. At the end of this time, a count of the insects on a small portion of the surface, from which was estimated the total number, showed 7,400,— 370 of which were mosquitoes. The observation is of interest as showing the remedy to be an effective one, and, further, that a single application of oil will remain operative for ten days or longer, although two rain storms occurred during the interval. The matter is worthy of further observation and experiment.

JOSEPH F. JAMES.

Washington, D.C., Oct. 10.

Phonetics in Science

FOLLOWING almost in the "wake" of the geological word-makers, who have apparently a dictionary of their own construction, comes another scientific writer who has decided to use the phonetic system of orthography. My attention was called to an article in a chemical journal published in this country, and almost at a glance I should have decided, had I not known the system, that the author had just finished writing a translation from the Spanish, and had his alphabet somewhat confused; for here before me was *sulfate;* but reading further, I should have said, perhaps, that he had just finished a German translation.

All this would have occurred to me if I had been ignorant of the existence of the phonetic system. Now, why did not this author change *phenol-phtalein*, which appears in the article referred to? Perhaps this word does not occur in the phonetic dictionary.

Is it not high time for American scientists to stop "coining" words? To be sure, these words differ from the geological ones in that they come well recommended by some philologists, and then the author in this case has not been guilty of owning an "orthographic mint." Why not continue to use the good old spelling, when it answers every requirement? The only disadvantage (?) in so doing, to my mind, may be in the fact that the words are longer than those in the phonetic system, and, as the advocates of this system claim, are more difficult to spell; so they are to some people, but unless they are foreigners, one is not in the habit of meeting such scientists in every-day life. Scarcely has our American language secured a strong foot-hold than it must be changed for the benefit of a few who would receive the honors as the originators and champions of a new system of orthography. I know of one advocate (not the author, it is needless to say, of the paper in the chemical journal above referred to) who "prides himself not only upon his ability to use the phonetic system, but also upon his beautiful English." Yet this very same man habitually uses, for example, such phrases as "Ain't he funny?" Still this hardly belongs to my criticism of phonetics in science. Why not leave the phonetic system to the philologists; why incorporate it in our scientific work?

When the advocates of this system have succeeded in establishing a strong foot hold for their system, and permanency (for it) stares the old system in the face — and let us hope that time is far distant — then we can almost picture our laboring scientists, with the new system (?) dictionary before them, ever fearful of beginning one word with an F after the new, and the next with a Ph after the system they have so successfully used for generations. E.

Grand-Gulf Formation.

DR. WM. H. DALL'S contribution to Miocene literature under this head calls for some notice, were it only to thank that eminent palæontologist for correcting my mistake with regard to the Gnathodon of Pascagoula and Mobile. With his unrivalled opportunities of comparison and long experience in these studies, his determination is naturally satisfactory and final. I knew that in mollusks the young and the adult forms often differ considerably; but I knew not the life history of this one.

It is complimentary to me also that he has accepted my outline of the evolution of the Florida Peninsula,[1] although he probably arrived at his conclusions from different and independent sources. And I wish to correct the impression he seems to have of my notions of the genesis of the Grand Gulf. I do not say that the Pascagoula is a deep-sea formation, but speak of it as a "marine aspect" of the more intensely fresh-water Grand Gulf on the Mississippi; and I do not suppose that in an estuary marine influences prevail over the fluviatile, in order to foster the life of any of the creatures that have left their remains in these calcareous clays and sands; so that it may be said to be "partially of marine genesis." The same views here expressed by Dr. Dall were indicated by myself in another paper published by the Geological Survey of Alabama on the "Nita Crevasse" in 1889, in which I speak of the progress of later formations on and in the Mississippi Sound and its older extension as presenting a "marine-aspect" of the "Port-Hudson group" of Dr. Hilgard, and sufficiently different to be called the Biloxi Formation — a nomenclature I understood to have been approved by him among others. The method of genesis sketched in that paper for the Port Hudson was considered applicable to the older Post-Eocene formations of the same embayment.

I do not perceive, therefore, that Dr. Dall's "correction of my definition of these clays" was "required;" nor have I any to make of his, for similar views have been elaborated for the forthcoming Alabama Geological Report, which will be in effect a new edition of Bulletin 87 of the United States Geological Survey.

The only criticism here to which Dr. Dall might seem amenable is a tacit endorsement of his own brochure of January last upon these same Miocene formations, in which it may be said he has permitted conjecture upon general principles somewhat to outrun and forestall positive discovery. Hasty generalization is the bane of science. The Pascagoula Clays may be equivalent to his Chesapeake, but the testimony as yet can scarcely be said to be satisfactory. Whilst he has shown the younger Miocene of northern Florida, originally named by me the Waldo Formation, phases of which are seen at White Springs, in Hamilton County, and in the overlying clays at Aspalâga on the Apalachicola River, to be Chesapeake; this surely cannot be identical with the upper layers at Alum Bluff, much less with the lower.[2] As he himself has shown, the latter is an older Miocene, identical with that occurring on Chipola at Bailey's Bridge, and called by myself Chipola at a time when, from high water, I had not seen the *Ortholax beds* at Alum Bluff, and when I had not seen the perfect instance of contact and overlap presented at that place. At that time, I had previously discovered a Miocene in the vicinity of Defuniak Springs, on Shoal River, and on Alaqua River (and named it from the last), tracing it across Choctawhatchie, near Knox Hill, and across Washington County a little south of Vernon, and across Chipola at Abe Springs, eight miles south of Ten-Mile Bayou, the principal site of the older Miocene. With the help of Mr. Jüssen (both of us then working with Mr. Geo. H. Eldridge on the geological

[1] See Dr. J. W. Spencer's First Report of the Geological Survey of Georgia, p. 60; and short papers of my own, read severally at the meetings of the Geological Society of America, August, 1891, and August, 1892.

[2] There is no fossiliferous formation at Hawthorne, nor any at Ocheesee, as Dr. Dall seems to suppose.

survey of Florida) the differences between these two formations was established, and for the younger the name of Aliqua revives. Whether this is identical with the Chesapeake and Carolinian or not is for another discussion At the same time the same parties identified the Chattahoochee beds of Langdon, which underlie the Miocenes of Georgia and northern Florida, with the Chipola beds, and traced their continuity westward across the Choctawhatchie, until, meeting with the syncline of the great roll from Alabama, they sink out of sight under the great sand-beds which fill the depression now drained by Shool River.

The connection of these two Florida Miocenes with the eastward extension of the Grand Gulf into south Alabama is matter for field research, and cannot be decided in the closet upon general principles. Enough is certain, however, to render it clear that if it is proper to draw the line between an older and a younger Miocene in Florida, such a distinction continues westward into Alabama and Mississippi; and where can we draw it better than upon lithological grounds between the water-holding stratified sands and sandstones of the lower Grand Gulf and those overcapping clays which, pierced at Brewton and Pallard 70 feet, at Mobile 735, at Biloxi 770, at Pearl River 800, and at New Orleans 1,200 feet, yield similar flows of water with similar clays and fossils? Of the latter I have other collections, which shall be submitted to Dr. Dall, now that I know his attention has been turned to the matter.

Upon the use of the term *formation*, I finally have to say that it is at least provisional, for every discoverer to name every structure he finds having peculiarities from some locality where it is prominently developed, although in the course of palæontological research many of these provisional names may disappear; and I submit that the prevailing American practice is not an abuse. For these reasons I shall still insist upon the propriety of calling the Pascagoula Clays the Pascagoula Formation.

LAWRENCE C. JOHNSON.

Meridian, Miss., Oct. 2.

Jealousy in Infants.

OF my two children one is a boy of four years, the other a girl of ten months. The boy has just returned home after an absence of some months. His sister displays great affection for him. She is also much attached to her nurse, more so at times apparently than to any other member of the household.

Now if, while the girl is sitting on a mat alone or on the lap of either of her parents, the nurse should take the boy upon her knee and fondle him, the girl will immediately cry out in a distressful way, in a tone not precisely indicative of anger or vexation, but more nearly similar to the tone of grief or disappointed desire. In the case described the infant will not be appeased unless the nurse puts down the boy and takes her up It will not avail for the nurse to take her up on one knee, leaving the boy on the other.

If, however, while the nurse has the infant in her arms either of the parents takes up the boy and caresses him, the girl displays only a strong interest, but no annoyance whatever.

It is evident then that the outburst of feeling in the former case was a display of jealousy. And, as the child is not precocious, it is allowable to look upon this case as an instance of ordinary mental development in children.

It is wonderful enough that infants of a few weeks or months should make unmistakable manifestations of the simpler emotions of fear, affection, and anger. But that an emotion so complex as jealousy should appear so early as at the age of ten months is especially remarkable, and indicates a degree of development at this age which, in the absence of observation, might justly be deemed incredible.

I have not by me the works of Taine, Preyer, or Perrez, and so am not able to say what observations, if any, they made in respect to this particular matter. Darwin observed jealousy in an infant of fifteen and a half months, but adds, "it would probably be exhibited by infants at an earlier age if they were tried in a fitting manner."

A. STEVENSON.

Arthur, Ontario, Canada.

Is There a Sense of Direction?

THE recent articles in *Science* by Dr. Hall and Dr. Work on this subject tempt me to say that in early life I was a believer in this sense, my belief being derived from Cooper's Leather Stocking Tales and similar sources. The winter of 1855–56 was spent in what was then called "the bad-axe country" of western Wisconsin, in company with an old French-Canadian trapper, who seemed to possess this gift in a (to me) marvellous degree; and, as he boasted of it and never to my knowledge made a mistake, my belief in this sense was confirmed.

The next winter, with a very limited knowledge of the Ojibwa tongue, picked up on the Bad Axe, I went with a government survey into northern Minnesota in the capacity of interpreter. Here the subject was discussed in camp, and the sceptics proposed a test. Five Indians were blind-folded, turned around several times, and led half a mile from camp in different directions. Not one could point to the camp until the bandage was removed from his eyes, nor could they point to the north. As soon as they could see they easily found the camp, although it was in the flat, low-rolling country north-east of Crow Wing, where there are no prominent land marks to be seen from the heavy-timbered lands. On several other occasions it was found that the Ojibwa was guided by the lie of the land, as indicated by water-courses, the twist of trees as seen on stubs denuded of bark, the sun, and the many minor indications of the cardinal points that are known to expert woodsmen, both white and red. Therefore I agree with Dr. Hall that man does not possess an instinct which teaches him to find his way to a given point regardless of darkness or of previous knowledge of locality.

I cannot agree that any animal possesses this sense. If so, it would be the wild animals, whose necessities would keep the sense in training, and not those whose needs have been supplied by man. Dr. Hall cites the cat, which has been taken in a box for fifty miles and yet reached home. This may be so; but such instances, if true, are recorded as wonderful, as they truly are; while the thousands of other cats which were taken less than five miles from home and never returned are never recorded. Dr. Work mentions the many carrier pigeons which never return, and it is generally conceded that these birds depend on sight alone, their trainers taking them short distances at first, and then increasing them until they know the way to the loft.

Let us take the case of the greatest of all migrating animals, the wild goose. All of us who have seen anything of these birds have seen them lost in a fog. Dr. Work thinks their flying at different altitudes may be determined by "the character of the upper currents," and if these currents determine the density of fogs, he is right; for on a clear day, when the geese can see many miles ahead and get a bird's-eye view of landmarks fifty miles distant, they fly very high, but let rain or mist prevail, and they drop within reach of gun-powder, because they must come near the earth to get their bearings and preserve the direction of their flight, by vision alone.

I have, among my flock of wild fowl, a pair of brant, *B. bernicla* (the only goose that Atlantic coast gunners call "brant," although in the West every goose is a "brant," except the Canada goose). One of these birds strayed from a flock going north in the spring of 1890, during one of the darkest of nights, when the rain came as hard as rain can come, and was captured while flying around a street-lamp in the village, thoroughly bewildered. The other was taken the same night two miles south of the village by a boy who found it on the ground. Such instances are common in every rural locality, not only with the "black brant," but with its larger relative the Canada goose as well; and if there are better navigators in the animal world who should have the "sense of direction," if there is such a sense, I do not know what animals they are.

Dr. Work covers the case in his last paragraph, when he says: "Whatever instincts animals may have in this direction, man has the same, with the additional faculty of reason." That is, he covers the question of a "sense of direction" in animals, and allows man as much; but I cannot subscribe to his implied assumption of reason by man alone. That, however, is another question.

FRED MATHER.

Cold Spring Harbor, N.Y.

Monstrous Poppy.

THE monstrous poppy described by Mr. Clark in *Science* for Oct. 7 is one of pistillody rather than "gynandry," and it is by no means so new a thing as he supposed. Masters (*Veg. Teratol*, p. 304) describes and figures similar monstrosities, and refers to Goeppert, who, as long ago as 1850, "found numerous instances of the kind in a field near Breslau." This pistillody of the poppy is mentioned also by Frank (*Krankheiten der Pflanzen*, p 250), who reproduces Master's figure. CHARLES E. BESSEY.

University of Nebraska, Lincoln.

Yeasts as Expounded in the "North American Review."

WHY does Mr. Lockwood revive the old idea that yeasts "beget moulds?" In an interesting but inaccurate article entitled "The Hygiene of the Atmosphere" in the *North American Review* for this month there is the following paragraph: "Omnipresent in the atmosphere are the invisible spores of the fungi, know as the *Torulacei*. They beget many of the mould and mildews seen on decaying vegetation. Some of these act also as ferments, decomposing vegetable and animal matter. Of this group, for good and evil, the air almost everywhere contains the spores of *Torula cerevisiæ* or yeast fungus, literally the mother of vinegar, alcohol, and leavened bread."

The classical researches of Brefeld and Hansen have long ago exploded the notion that the yeast plant is only an immature form of a species of mould. The terms *Torulacei* and *Torula* are also out of date, *Saccharomycetes* and the generic name *Saccharomyces* being mostly used at present. It is true there is some diversity of opinion as to the systematic position of the yeasts. Some think they constitute a distinct class; the majority of botanists believe, however, that they are degenerated forms of the *Ascomycetes*. There is absolutely no reason for the statement that the mother of vinegar is another form of the yeast fungus. They are by no means different stages of the same plant, and are only related in that they are both fungi. Hansen has proved that *Saccharomyces erevisiæ* and *Saccharomyces pastorianus* are beer ferments, and that *Saccharomyces ellipsoidens* is the wine ferment. *Mycoderma aceti* occasions acetic fermentation. Chemically these processes are even more distinct. The former converts certain carbohydrates into alcohol and other products with the evolution of carbon dioxide; while by means of the presence of *Mycoderma aceti* alcohol is oxidized into acetic acid or vinegar. By means of the solid culture media, gelatine and agar agar, introduced for the cultivation of bacteria, white, black, and pink yeasts have been carefully studied, principally by Hansen. Besides budding or gemmation there is another mode of reproduction in the yeasts. The protoplasm of the cell forms spores, and the cell-wall becomes an ascus. They are therefore called ascospores, and the yeasts are considered degraded ascomycetes. JOHN GIFFORD.

Swarthmore College, Pa., Oct. 8.

BOOK-REVIEWS.

Man and the Glacial Period. By G. FREDERICK WRIGHT. New York, D. Appleton & Co. 1892. 8°. 385 p. Ill.

AS a glacialist, the author of this volume stands among the first in this country, and his long study of that remarkable period in the geologic history of our planet invests all he says about it with uncommon authority. In his work, proceeding in a true scientific manner from the known to the unknown, he first describes the main existing glaciers in various parts of the world, and devotes a chapter to the physics of glacial motion. Summing up the signs of past glaciation, he examines separately the ancient glaciers of the Western and of the Eastern Hemispheres, describes at considerable length the drainage systems both in America and Europe, and directs especial inquiry into the cause of the glacial period and its probable date.

All this is well done, and supplies the most compact and satisfactory exposition of our knowledge of the subject which has yet appeared, — the facts carefully stated and the opinions maturely formed. To a very important chapter, and the one which for many readers will be the most interesting in the book, such unreserved praise cannot be extended. This is the chapter on the "Relics of Man in the Glacial Period." The author believes there are such relics both in Europe and America, and that they have been discovered and proved. No one will deny that there may be such; it is likely enough; but that any such relics have been found under conditions which remove all doubts as to their authenticity and age is open to considerable question.

Confining our attention to examples in the United States, let us see what is offered. His first instance is the rough implements found by Dr. Abbott in the Trenton gravels. But these gravels are unquestionably post-glacial, and no one can say how much *post*. The late eminent glacialist, Dr. Carvill Lewis, considered them rather modern, and also maintained that what Dr. Abbott believed to be undisturbed layers, were those of an ancient talus. These statements Dr. Lewis made at an open meeting of the Academy of Natural Sciences, Philadelphia, not long before his regretted death, concerning specimens from Dr. Abbott which I then laid before the Academy. It is the opinion of most glacialists that the Trenton-gravel finds require further study before we can assign their probable age. I have myself found these chipped stones in the Trenton talus, but never in clearly undisturbed strata.

Dr. Wright's next examples are the finds of rough implements, in the glacial gravels in Ohio, by Dr. Metz, Dr. Cresson, and Mr. Mills. The two first-named are eminent archæologists, but neither is a geologist, and it may as well be accepted once for all that no opinion as to the age of a gravel can be received from any but an expert geologist, one who has specially studied this most difficult subject. Not one of these finds, therefore, is conclusive.

The next example offered is the discovery of flint chips and implements in the alleged glacial gravels by Miss Babbitt, near Little Falls, Minnesota. This locality has been re-examined this year by members of the Bureau of Ethnology, with the result of proving that the implement-bearing layer is unquestionably modern, and not glacial, nor post-glacial.

Next, the alleged implements from the Columbia gravels at Claymont, Del., are adduced. These gravels are far older than the last glacial action, and it would indeed be wonderful were they deposits of human industries. I can say that the discovery of such in them is wholly rejected by McGee and Holmes, who have closely compared all the evidence; and I add that the supposed implements from them which I have examined show no sure signs of human workmanship; while the argillite pieces certainly come from a talus.

The remains under Table Mountain, California, which are next brought forward, have been unanimously denied by archæologists any great antiquity. They belong to a modern industry, and in all probability were left in their shafts by the aboriginal gold-diggers a few centuries before the conquest. The manner of their deposition alone proves this, and the case is given up by Professor Haynes, in his excellent Appendix to Dr. Wright's book.

Dr. Wright's last example is the feeblest of all — the Nampa image, a "beautifully-formed clay image of a female," said to have been brought up from a depth of 320 feet (!) in the boring of an artesian well, at Nampa, Idaho. It is sad to destroy illusions; but when this same image with its story was laid before a well-known government geologist, and he at once recognized it as a clay toy manufactured by the neighboring Pocatello Indians, the person displaying it replied with engaging frankness, "Well, now, don't give me away!"

These are Dr. Wright's evidences of glacial man in America. It will be seen that his structure is rather slight. Very much more solid evidence than any yet brought forward will be necessary to establish this most important fact. D. G. BRINTON.

AMONG THE PUBLISHERS.

"THOUGHTS of Busy Girls" is the title given to a volume of short essays from the pens of working girls, which Miss Grace M. Dodge, the well-known philanthropist, has edited and prefaced. These essays are quite remarkable, considering the disadvantages

under which the writers worked. While they may occasionally trip in their grammar, they show intelligence and thought and have the merit of having been written with all seriousness of purpose. They should act as a stimulant to other working girls. The Cassell Publishing Company will issue the book.

—Messrs. D. Appleton & Co's list of autumn announcements includes, among other titles, "An Attic Philosopher in Paris," by Emile Souvestre, illustrated by Jean Claude, and uniform with "Colette;" "The Story of Columbus," by Elizabeth Eggleston Seelye, edited by Dr. Edward Eggleston, with one hundred illustrations by Allegra Eggleston; "Three Centuries of English Love Songs," edited by Ralph Caine, with frontispiece after Angelica Kauffman; "Abraham Lincoln, the Story of a Great Life," by William H. Herndon and Jesse W. Weik, with an introduction by Horace White, and many illustrations; "Admiral Farragut," by Capt. A. T. Mahan, and "Zachary Taylor," by Major-General O. O. Howard, U. S. A., the first two volumes in the Great Commander Series, edited by General James Grant Wilson; "Man and the Glacial Period," by Professor G. Frederick Wright; "Along the Florida Reef," by Charles Frederick Holder, illustrated; "Warriors of the Crescent," by W. H. Davenport-Adams, illustrated, and uniform with "Pictures from Roman Life and Story," by Professor A. J. Church; "North America, Vol. III., the United States," by Élisée Reclus; "Modern Mechanics," a supplementary volume to Appleton's Cyclopædia of Applied Mechanics, illustrated, edited by Park Benjamin, LL.B.; "Appleton's Atlas of Modern Geography," with maps and illustrations of all countries; "Idle Days in Patagonia," by C. H. Hudson, C. M. Z. S., author of "The Naturalist in La Plata;" "Moral Instruction of Children," by Felix Adler, a translation of "Rousseau's Emile," by W. H. Payne, Ph.D , LL.D., and "English Education in the Elementary and Secondary Schools," by Isaac Sharpless, in the International Educational Series; and new editions of "An Englishman in Paris," in one volume; "Lecky's History of England in the Eighteenth Century," in twelve volumes, of which five are devoted to Ireland; Herbert Spencer's "Principles of Ethics," Vol I.; Huxley's Essays upon some "Controverted Questions;" Tyndall's "Fragments of Science;" and the authorized edition of the "New Drill Regulations of the United States Army."

—The Quarter Centennial Programme of the Kansas Academy of Science, held at Atchison, Oct. 12, 1892, contained the following papers: The Descent of Facial Expression, A. H. Thompson, Topeka; Notes on the Distribution of Kansas Rushes and Sedges, M. A. Carlton, Manhattan; Notes on Ampelopsis quinquefolia Michx., Variation, E. B. Knerr, Atchison; The Relations of the Composite Flora of Kansas, A. S. Hitchcock, Manhattan; A List of Flowering Plants and Ferns collected in Franklin County, Kansas, during the months of April, May, September, and October, 1890-92, W. E. Castle, Ottawa; Some Ornamental Kansas Stones, S. W. Williston, Lawrence; The Analysis of Kansas Building Stones, E. H. S Bailey and E. C. Case, Lawrence; Some Notes on Condensed Vegetation in Western Kansas, Minnie Reed, Manhattan; The Organization and Work of Local Scientific Clubs, T. H. Dinsmore, Emporia; On the Horse Flies of New Mexico and Arizona, C. H. Tyler Townsend, Las Cruces, N. M.; Note on Peculiar Acalyptrate Muscid found near Turkey Tanks, Arizona, C. H. Tyler Townsend; The Characteristics of the Glacial Area of North-east Kansas, Robert Hay, Junction City; Kansas Niobrara Cretaceous, S. W. Williston, Lawrence; The Variation in Chemical Composition of Plants Collected at Different Seasons of the Year, Illustrated by the Common Dandelion, L. E. Sayre, Lawrence; Joseph Savage — A Memorial, Robert Hay; Astronomical Phenomena in 1892, T. H. Dinsmore; Notes on a Pink Barite Found in Atchison Limestone, with Analysis, E. B. Knerr; Notes on Colorado "Mountain Leather," with Analysis, E. B. Knerr; Notes on Comparative Insect Anatomy (a Laboratory Guide), V. L. Kellogg, Lawrence; Insect Notes, V. L. Kellogg; An Interesting Food Habit of the Plesiosaurus, S. W. Williston; The Archæan Area of Missouri, E. Haworth, Lawrence; On Para-chlor-meta-

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Oct. 15.—Obituary notice of Mr. A O. Aldis, by Mr. Jos. K. McCammon; Obituary notice of Mr. William Ferrel, by Mr. Cleveland Abbe; Obituary notice of Mr. J. E. Hilgard, by Mr. O. H. Tittmann; Obituary notice of Mr. C. H. Nichols, by Mr. J. M. Toner; Obituary notice of Mr. C. C. Parry, by Mr. F. H. Knowlton; Obituary notice of Mr. George Bancroft, by Mr. J. B. Marvin.

Biological Society, Washington.

Oct. 22.—The principal topic of the evening, Botanical Nomenclature: (*a*) The Present Status of Botanical Nomenclature, by F. C. Coville; (*b*) Report on the Botanical Congress at Genoa, by Geo. Vasey; (*c*) Some Controversial Points in Botanical Nomenclature, by George B. Sudworth. Other communications: Discovery of Fossil Plants in the Potomac Formation, at the New Reservoir, Washington, D.C., and at Mount Vernon, and Discovery of a Second Specimen of Saul's Oak (Quercus Prinus + alba), by Lester F. Ward; The Fauna and Flora of Roan Mountain, North Carolina, by C. Hart Merriam.

Engineer's Club, Philadelphia.

Oct. 1.—Strickland L. Kneass, The History and Development of the Injector; Carl G. Barth, Distribution of Pressure in Bearings.

Publications Received at Editor's Office.

FOREL, F. A. Le Léman, Tome I. Lausanne: F. Rouge. 8°. Paper. 526 p.
HARVARD GRADUATES' MAGAZINE. Vol. I., No. I., Oct., 1892. Boston, The Harvard Graduates' Magazine Association. 8°. Paper. 176 p. 50c.
LODGE, OLIVER J. Lightning Conductors and Lightning Guards. London, Whittaker & Co. 12°. 556 p.
MONTMAHON AND BEAUREGARD. A Course on Biology. Translated by Wm. H. Greene. Phila., J. B. Lippincott Co. 12°. 868 p. 75c.
U. S. DEPARTMENT OF AGRICULTURE. Report of the Chief of the Weather Bureau for 1891. Washington, Government. 8°. Paper. 91 p.

nitro-benzyl-chloride and its Derivatives, E. C. Franklin. Lawrence; Harmonic Forms, B. B. Smyth, Topeka; The Effect of Some Grass Diseases on the Tissue of the Host, W. C. Stevens, Lawrence; Some Useful Apparatus for the Botanical Laboratory, W. C. Stevens; On Echinacea angustifolia, S. R. Boyce. Lawrence; Additions to the Flora of Kansas, B. B. Smyth, Topeka; Catalogue of the Kansas State Herbarium, B. B. Smyth; Additions to the Minerals of Kansas, G. H. Failyer and E. H. S. Bailey; The Yield of Extractive of Various Vegetable Substances, L. E. Sayre; A Breathing Well in Logan County, Kansas, J. T. Willard, Manhattan; The Improvement of Sorghum by Seed Selection, J. T. Willard; A Résumé of the Current Opinion on the Structure of the Nervous System, C. Judson Herrick, Ottawa; Maximum Binding Moments for Moving Loads in a Swing Beam, E. C. Murphy, Lawrence; Notes on some Kansas Weeds, A. S. Hitchcock; The Distribution of the Genus Vitis in Kansas, A. S. Hitchcock; Notes on the Occurrence of Granite in a Deep Boring in Eastern Kansas, Robert Hay.

— Macmillan & Co. are to publish very shortly a work by Dr. S. S. Laurie entitled "The Institutes of Education, comprising a Rational Introduction to Psychology." Dr. Laurie is author of "Occasional Addresses on Educational Subjects," "Lectures on Language and Linguistic Methods," etc., and writes from long experience on the meaning and importance of a science of education.

— Macmillan & Co.'s October announcements include, The Beauties of Nature, and the Wonders of the World We Live In, by Right Hon. Sir John Lubbock; Charing Cross to St. Paul's, by Justin McCarthy, illustrated by Joseph Pennell, new edition; The English Town in the Fifteenth Century, by Alice Stopford Green; Sketches of Life and Character in Hungary, by Margaret Fletcher; History of Federal Government, From the Foundation of the Achaian League, General Introduction, History of the Greek Federations, new edition; Life in Ancient Egypt, translated from the German of Professor Erman by Mrs. Tirard; A Defense of Philosophic Doubt, by the Right Hon. A. J. Balfour, being an Essay on the Foundations of Belief, new edition; The Theory of Wages, and its Application to the Eight-Hours Question, by Herbert M. Thompson; A text-Book of Pathology, Systematic and Practical, by Professor D. J. Hamilton, Vol. II.; A Text-Book of Physiology, Part V. —Appendix, The Chemical Basis of the Animal Body, by A. Sheridan Lea; Metal Coloring and Bronzing, by Arthur H. Hiorns; Hygiene, by Edward F. Willoughby, new and enlarged edition; Scientific Papers, by Oliver Heaviside, two volumes; Pioneers of Science, by Professor Oliver Lodge, with portraits and other illustrations; Hereditary Genius, An Inquiry into its Laws and Consequences, by Francis Galton, F.R.S., new edition; Chemical Theory for Beginners, by James Walker and Leonard Dobbin; Materials for the Study of Variation in Animals, Part I., Discontinuous Variation, by William Bateson; On Color Blindness, by Thomas H. Bickerton; The Great World's Farm, or, How Nature Grows Her Crops, by Selina Gaze, with a Preface by Professor Boulger; Text-Book of Embryology, Man and Mammals, by Dr. Oscar Hertwig, translated and edited from the Third German Edition by Dr. E. L. Mark; Text-Book of Embryology, Invertebrates, by Drs. Korschelt and Heider, translated and edited by Dr. E. L. Mark and Dr. W. McMichael Woodworth; The Photographer's Pocket-Book, by Dr. E. Vogel, translated by E. C. Conrad; Physiological Psychology, by Dr. Th. Ziehen, adapted by Dr. Otto Beyer and C. C. Vanliew; The City State of Greek and Roman Antiquity, by W. Warde Fowler; Atlas of Classical Antiquities, edited for English use by Professor W. C. S. Anderson; Principles of Elementary Algebra, by Nathan F. Dupuis; Introductory Modern Geometry of the Point, Ray, and Circle, by William B. Smith; The Elements of Graphical Statics, A Text-Book for Students of Engineering, by Leander M. Hoskins; A Review of the Systems of Ethics founded in Evolution, by C. M Williams; and Theory of Functions, by James Harkness.

TO THOSE INTERESTED IN SCIENCE.

[Science (weekly) established in 1883, N. D. C. HODGES, 874 Broadway, New York City.]

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Bird on Its Nest, The.
Birds Breeding at Hanover, N. H.
Botanical Laboratory, A.
Botanists, American and Nomenclature.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diamonds in Meteorites.
Diphtheria, Tox-Albumin.
Dynamics, Fundamental Hypotheses of.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
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THE ISOLATION OF RENNET FROM BACTERIA CULTURES.

BY H. W. CONN, WESLEYAN UNIVERSITY.

EVER since the beginning of the study of micro-organisms it has been a debated question whether fermentations are to be regarded as biological or purely chemical phenomena. Beginning with the work of Schwann and others in the early part of the century, careful experimentation aided by microscopic study seemed to point to a biological explanation of nearly all forms of fermentation. The work of the third and fourth decades of the century proved beyond question that most fermentations were always intimately associated with the growth of micro-organisms, and the inference was a natural one that the micro-organisms themselves were the cause of the fermentations. Shortly after the valuable work of Schwann, however, appeared the brilliant investigations and discussions of Liebig upon fermentations in general. By Liebig all fermentations were regarded as purely chemical phenomena and the presence of micro-organisms was regarded only as a concomitant incident. According to him all albuminous matter was thought to tend spontaneously toward decomposition, and such decomposition was the basis of fermentation and decay. This, the chemical theory, was for twenty years the favorite theory. The biological and chemical theories were very rigidly opposed to each other and supposed to be contradictory. With the work of Pasteur and the great development of the study of micro-organisms thereby inaugurated, the biological theories of fermentations again came to the front, rapidly gained the ascendency, and soon displaced almost entirely the chemical theory as advanced by Liebig. For the next twenty years it was regarded as an almost settled fact that most natural fermentations were biological phenomena, and the theory of Liebig was at last practically abandoned.

Within still more recent times there has been a partial swinging back of the pendulum toward a chemical explanation of many forms of fermentation at least. This has not, however, been in the direction of Liebig's theory, but rather toward a theory of the action which unites together a chemical and biological explanation. It has been recognized for more than half a century that there are forms of ferments, such as pepsin, trypsin, etc., which do act in a purely chemical manner. These ferments, it is true, are produced originally by living organisms, but when once produced they are not living themselves, at least in any proper sense, and their action is not dependent upon growth or multiplication, for they are not organisms. So far as can be determined their action is purely chemical. On the other hand, a large number of fermentations, such as the alcoholic fermentations, the souring of milk, etc., have been traced with certainty, not only to living organisms in the form of bacteria and yeasts, but to the actual growth and multiplication of these organisms. These fermentations occur only when micro-organisms are present and only when these micro-organisms grow and multiply. The amount of growth of the organism is a measure of the amount of fermentation. Undoubtedly these biological fermentations are of a different nature from the other class. We are, however, learning now to look upon some of the biological fermentations as chemical in their immediate nature.

In the first place, the bacteriologist has been learning that germ diseases, which are caused primarily by the growth of micro-organisms in the body, are caused immediately by certain poisonous bodies which these organisms produce. He has called these bodies ptomaines, and at present biologists are very rapidly becoming convinced that it is the direct action of these poisonous materials which produces the symptoms and disturbances associated with most germ diseases. It is not the simple growth of bacteria which produces disease, but the poisonous products of their growth; and thus a chemical explanation is added to the biological.

Not only in germ diseases but in other forms of fermentations, not associated with disease, bacteriologists are learning of the production of chemical ferments by the micro-organisms. Many organisms have been found to produce dyastase, sucrase, glucase, etc. Within the last year or two it has been demonstrated that many bacteria produce a chemical ferment very similar in its character to trypsin. The general class of bacteria which liquefy gelatin have long been known to have an action quite similar to that of pancreatic juice. Indeed, it is this peptonizing action which is the cause of the liquefaction of the gelatin. Recently Brunton and Macfadyen and especially Fremi have succeeded in actually isolating from bacteria cultures a chemical ferment which has this power even when acting in sterilized media.

Some recent work in the bacteriological laboratory at Wesleyan University has isolated another chemical ferment from bacteria cultures. A large class of bacteria have the following actions on milk: They first curdle the milk rendering it slightly alkaline; subsequently the curd is slowly dissolved into a more or less watery liquid. Chemical study shows that this last action is a simple digestion and peptonization of the curd and that it is due to the trypsin-like ferment above mentioned. The curdling, which precedes the digestion, however, must be due to a different action, inasmuch as trypsin produces no curdling of the milk. It has been suspected for some time that this curdling is really due to a "rennet-like" ferment which is produced by the bacteria. It has been my good fortune recently to demonstrate the truth of this supposition. My method of work has been as follows:—

The bacteria in question are cultivated in milk for several days, in some cases for two weeks. By this time the curd is precipitated and at least partially dissolved, and the result is a somewhat thick liquid containing, of course, immense numbers of bacteria. This liquid is filtered through a porcelain filter to remove organisms, and a clear, usually amber-colored, filtrate is thus obtained. The filtrate, of course, contains in solution all of the soluble chemical ferments which may have been formed by the bacteria. This filtrate is now acidified with H_2SO_4 and then common salt is added to a state of super-saturation. When this condition is reached there appears on the surface of the liquid a considerable quantity of snow-white scum. This scum is removed from the liquid, purified if necessary by reprecipitation, and then dried. It produces a snow-white powder, which upon experiment is found to be active in its curdling action upon milk and to have all of the essential characters of rennet. The ferment which is thus obtained is not chemically pure, containing, besides the rennet ferment, a varying amount of the tryptic ferment formed at the same time. But the rennet ferment is most abundant and is very active. This ferment can be kept indefinitely, is killed by heat, acts best at a temperature of 30°–35° C., and curdles sterilized milk under proper conditions in half an hour. Experiment shows that no organisms are present in the curdled milk, and there is thus no doubt left that we are dealing with a chemical ferment similar to rennet, and which is produced by the growth of these micro-organisms in milk. The ferment does not appear to be exactly identical with rennet, some of its chemical tests being different. This may be due to the impurities which are present or to an actual difference in the ferment.

A large number of bacteria possess this power of producing rennet, though not more than nine or ten have thus far been experimented upon. Those studied differ much in the amount of the ferment produced, some giving large quantities, and others only traces. Thus far it seems that all species of bacteria which liquefy gelatin produce this rennet ferment, although some of them only in small amount.

This general line of work is thus leading bacteriologists to a better understanding of the fermentations, although we are as yet doubtless far from any real knowledge of their nature.

IS THE SÂO FRANCISCO DO SUL (SANTA CATHARINA) IRON A METEORITE?

BY ORVILLE A. DERBY, SÂO PAULO, BRAZIL.

THE possibility of a terrestrial origin for masses of native iron being established by the well-known occurrence at Ovifak, Greenland, doubt may be cast on the mode of origin of such so-called meteorites as in their chemical and physical characters depart widely from the ordinary type of meteoric iron. From its size and prominence in meteoric literature the most important example of such a doubtful iron is that found in 1875 near the city of Sâo Francisco do Sul, in the State of Santa Catharina, Brazil, and generally known as the Santa Catharina iron or meteorite. Professors Daubree and Stanislas Meunier regard it as undoubtedly meteoric; while Dr. A. Brezina, whose opinion is equally entitled to respect, considers it as probably terrestrial, placing it alongside of the Ovifak iron in his catalogue of the Vienna collection.

So far as known to the writer, no such minute study as Brezina, Cohen, and others have given to various undoubted meteorites has as yet been made of the Ovifak iron, so that at present we are in the dark as to whether or not it presents definite criteria by which a terrestrial iron can be positively separated from a meteoric one. So many of the characteristics once presumed to be purely meteoric have already been noticed, either in the Ovifak or artificial irons, that it may be doubted if any such definite criteria exist. The published analyses of Ovifak show that neither the nickel-iron alloys nor the association with a monosulphide (troilite) carbon free or combined and phosphorus can be taken as distinctive of meteorites. It is not clear, however, if the carbon presents the same form as in meteorites, that is to say, free in the form of amorphous carbon, graphite, cliftonite, diamond (?), etc., and combined as cohenite, nor if the phosphorus is combined with iron and nickel as in the meteoric minerals schreibersite and rhabdite. On the other hand, the compact (*Dichte Eisen*) group of Brezina containing at least nine undoubted meteorites, one of which, Nedagolla, was seen to fall, proves that the absence of a certain crystalline structure, indicated by the so-called Widmanstätten and Neumann figures, is not necessarily proof of non-meteoric origin. On the contrary, evidence is accumulating that a very similar if not absolutely identical crystalline structure may, under favorable circumstances, appear in artificial irons. Huntington has illustrated figures very like those of Widmanstätten in spiegel-eisen; Linck has described a crystal from a furnace slag, with cube faces and a polysynthetic twinning structure, which he identifies with the Neumann figures, and a perfect octahedral crystal with a similar twinning structure has recently come into the possession of the writer from a Brazilian blast-furnace.

It may be presumed that it is mainly on the absence of the characteristic meteoric figures that Brezina depends in placing the Sâo Francisco do Sul with the Ovifak iron, as in no other respect are they markedly similar. The Brazilian iron does, however, show, at least in places, a very fine rectilinear cross-hatching indicative of polysynthetic twinning, but according to some law different from that giving the Neumann lines. Another point of agreement is in the abundant occurrence of the magnetic oxide of iron which is either absent from most meteorites or has been overlooked in their description. Both irons are brittle, being readily broken to fragments with a hammer, in which respect they differ from the tenaceous malleable metal of most meteorites. Both also crumble to fragments in the atmosphere of museums, though apparently not from the same cause, the crumbling of Sâo Francisco do Sul being due to alteration of the sulphide, which presumably is not the case with Ovifak.

Lawrence Smith and Becherel found the magnetism of the Brazilian metal abnormally weak but that it became normal on heating, from which they concluded that the mass could not have been subjected to great heat. There seems, however, to be a variation in this respect in different parts, since Daubree notes that many fragments exhibit polar magnetism while others do not. Any argument drawn from the magnetic properties would apparently tell as much against a terrestrial as a cosmic origin, since the only conceivable mode of terrestrial origin is in the midst of an igneous magma made fluid by heat.

In other respects, however, a parallel for the characteristic features of the Sâo Francisco do Sul iron is to be looked for in the group of meteoric irons rather than in those, so far as published, of the terrestrial iron of Ovifak. It is particularly characterized by the high percentage of nickel and the extraordinary abundance of sulphide. In the first respect its nearest ally is the Oktibbeha meteorite with nearly double the proportion of nickel, and not the Ovifak iron in which that metal is below the meteoric average. Unlike any other known iron, meteoric or terrestrial, the sulphide forms a gangue inclosing the metallic parts, but it is interesting to notice that it also presents itself in pencil-like inclusions in the metal, surrounded by carbon and other accessories, as in the Bendegó meteorite. The meteoric phosphurets, schreibersite and rhabdite, not yet described from, though perhaps present in, the Ovifak iron, are abundant accessories. In the carbonaceous residue, soft, friable granules, with a crystalline form suggestive of the cliftonite of the Youngedin, Magura, and Bendegó meteorites, have been noticed.

Thus, so far as at present known, the chemical and physical characteristics of the Sâo Francisco do Sul iron do not point very markedly to an association with that of Ovifak. What is known of the geological conditions of the place of discovery, although too incomplete to be decisive, points rather to a meteoric origin.

The geological information regarding the place of discovery is derived from verbal communications by the late Professor Ch. Fred. Hartt, a paper in the *Revista do Observatorio* de Rio de Janeiro for 1888 by Dr. Luiz F. Gonzaga de Campos, and a recent article in the *Jornal do Commercio* of Rio, May 29, 1892, by Dr. J. P. Calogeras. All these accounts agree in representing the island of Sâo Francisco do Sul as composed essentially of granitoid gneiss cut by dykes of tourmaline granite and diabase and covered by a heavily-wooded soil-cap due to the decay of the underlying rocks. That is to say, it is a typical locality of the coast-belt from Cape Frio to Montevideo, at any point of which, so far as geological indications go, native iron might be looked for with as great probability as at this particular locality. The rocks, granite, gneiss, and diabase, are well exposed about the shores of the island. The latter, which approaches most nearly in character the Ovifak rock, being apparently no more abundant than in any other similar locality. In the interior of the island the soil-cap and forest growth make geological observations difficult. Dr. Campos, in his examination of the place of discovery of the iron, opened numerous paths and pits, and on my recommendation paid particular attention to the question of the possible occurrence of basic rocks in immediate connection with the iron. He says, "Although the rock on this hillside is much altered, giving an argillaceous soil of a red color, here more, there less deep in tint, it shows perfectly in some points the mineral composition of granite. At the top of the hill near the point *c* [one of the points where masses of iron were found] there are large blocks of granite, at times tourmaliniferous. In the vicinity, in all the directions that I followed, all the soil is granitic. In the bed of the stream, which I ascended in various sections, the material was always that of the disaggregation of granitoid gneiss. Finally, I did not find at this place a single exposure of basic rock." The numerous specimens that have come to hand showing foreign material cemented to the iron by the limonite crust formed by its alteration are in accord with this description, indi-

cating, as Daubree has always remarked, that the iron rested on a granitic soil.

The topographical sketch of the locality made by Dr. Campos shows no indication of concealed dykes of basic rocks, which, according to universal experience of occurrences under similar conditions in Brazil, should, from their more ready decomposition, form depressions on the surface. The principal mass was found at the foot of the hill near a creek on the point of a spur, and aligned with a mass about 200 meters distant at the extreme summit of the hill and with an intermediate find close to an exposure of granite on the same spur. The other finds are aligned parallel to the course of the creek. In one pit on this line iron was found to a depth of 2.8 meters, covered with wash earth brought down by the rain from the higher portions of the hill.

Dr. Calogeras, who argues in favor of a terrestrial origin, presents no facts in disaccord with the above observation that the only rock known in the immediate vicinity of the iron is granitic. His argument, based on the occurrence in the region (principally at a distance of several miles) of iron and manganese ores (oxides), and presumed to be connected with dykes of diabase, and of a small percentage of nickel (0.30 per cent) in one of his specimens of an argillaceous manganese ore, has no direct bearing on the question of origin. Even if the native iron had been found resting upon the said ore deposits instead of several miles away, a genetic relation would still have to be proven, and until direct evidence was presented most petrologists would probably regard the relation as casual rather than genetic.

No specimens of the diabase of the vicinity of São Francisco have come to hand. Assuming that it is of the usual character of the diabases of similar regions in Brazil, it is not so unlike the basalt, or dolerite, of Ovifak that a comparison might not with propriety be made. It neither approaches nor differs from the iron-bearing Greenland rock more than do the normal diabases of other parts of the world, in which as yet nothing analogous with the Ovifak occurrence has been noted. If the diabase or some related highly basic rock had been found in immediate contact with the iron, a comparison with the Ovifak occurrence would be justified. but even then complete proof of a terrestrial origin would be lacking. As the case stands at present, with tolerably satisfactory evidence that the iron rested on highly acid rocks or their debris, the hypothesis of such an origin involves that of the formation of native iron under conditions entirely different from those of Ovifak.

Another argument in favor of the meteoric origin of the iron may be drawn from the state of preservation of the masses. Although the metal itself is more than usually resistant to oxidizing agencies and to the action of acids, the abundant presence of pyrite renders it peculiarly susceptible to alteration. All the smaller masses are completely changed to limonite, pieces of the size of a man's head or larger are in large part altered, but still show remnants of metal badly fragmented and oxidized in the centre, and only the larger masses retain perfectly sound metal and sulphide. Even in the dryer air of museums it is not a good-keeping iron, the disintegrating action of the decomposing sulphide being singularly favored by the fragmented condition of the metal. Under these circumstances it is extremely improbable that. buried in the soil and exposed to the extremely rainy climate of the coast region of southern Brazil, the iron could have been preserved for more than a few centuries at the utmost. The hypothesis of a terrestrial origin involves the exposure to destructive agencies through untold geological ages, since the present topographical features of this part of the Brazilian coast are unquestionably extremely old. In view of the Ovifak occurrence, it is possible and even probable that native iron of terrestrial origin simulating meteorites will be found in other parts of the world and perhaps in rocks of different petrographical types. It is not probable, however, that the first discoveries of this character will be made in surface exposures in the extremely humid coast region of southern Brazil, where the country rock is of Archean age, and the eruptives presumably date back to the beginning of the Secondary age, if not earlier.

NEW TREATMENT FOR SNAKE-BITE AND OTHER POISONS.

BY W. H. WOOSTER, PRESIDENT OF THE BALLARAT ASTRO-PHYSICAL SOCIETY, VICTORIA, AUSTRALIA.

As poisonous snakes are more or less common in many countries, and the circulation of *Science* is world-wide, and other cases of poisoning often occur, and as I have been the means of saving a life by a new process, one that can be applied when it is too late for the orthodox method of cutting and sucking, and used by anybody, with materials at one's hand in every house, I have concluded that I should not be doing my duty if I did not make it known. Some time since, when living in the country, one of the nicest little girls of my acquaintance, about four years of age, was brought to me by an elder sister for diagnosis and treatment. She was swelling from head to foot, becoming cold and stiff in the limbs, and losing her power to answer or even understand questions. As I had been the means of effecting several simple cures in the district, she was sent in the hope that I would be able to tell instinctively what was amiss, and to cure it as if by magic. As the sequel proved, the latter was almost realized, notwithstanding that in regard to the former I was quite at sea. She had never known what a snake was, but for strategic purposes, well-known to managers of children, had often been terrified with the name of "bulldog" without knowing what that was (bulldog was the popular name for a very poisonous, pugnacious, and gigantic ant, *Myrmecia vindex*); so that whenever she got stung or bitten by anything, it was put to the credit of the bulldogs, as on this occasion. She had screamed and fallen a few yards from the house, and told her mother a bulldog had bitten her on the foot; and that was all she knew. The foot was examined, but from running barefoot was so full of scratches and punctures that none could be fixed on as certainly the marks of snake-fangs. The mischief had occurred about an hour before I saw her, and while being examined she was getting rapidly worse: the swelling, coldness, and stiffness were becoming alarming, the lips as thick as one's thumb, the hollows on each side of the nose were filled up level, and of a steel-blue and sea-green color, the arms, lower limbs, and body were becoming blotched with irregular raised parts, white and hard, the spaces between being sunk and dark-purple; the pulse, too, was getting exceedingly feeble. Not thinking a bulldog ant could produce such effects, and not being certain that it was a snake-bite, I concluded that it might be a spider-bite, as my only brother had nearly lost his life from that cause. Even if the place of the bite or sting could have been found, it was clearly too late to cut and suck, for the poison was already all over the body, and rapidly mastering the vital functions; besides which, no one in the district had an ammonia syringe for hypodermic injection. The question was, What could be done? Precedent said: Send for a doctor. But there was none nearer than eight miles, and then he might not be at home; or, if at home, most likely intoxicated; and, besides that, she looked as though she would die before a doctor could see her.

In this conflict of thought and feeling, a happy idea struck me. I had proved in my own person the power of a hydropathic, hot-sweating-pack to produce a flood of perspiration, and throw off impurities from the blood, and it now occurred to me that if I could sweat the poison out from the whole surface, it would not matter where it got in, nor what put it there; and, moreover, that if it were any good, the danger would be over before anyone could get half-way to the doctor's; and, if twenty minutes or so produced no benefit, the doctor could still be sent for as a last resource. It was a great responsibility, but under the circumstances I felt it a duty, and went to work. Of course, there was no hot water ready, but we soon made some, and put it into a tub, into which the child was placed, with a blanket over all, tucked in close round the neck to keep the steam in, but leaving the head out. This was to open the pores of the skin quickly. While in this I spread a piece of oilcloth on the table, and a pair of blankets on that. As soon as more hot water was ready, a sheet was wrung tightly out of it, and spread on the blankets. The child was laid on this, and then first one side, and then the other lapped over her, and it was tucked in close about the neck; then the

blankets followed, and lastly the oilcloth, and she was put to bed, with another pile of blankets on top. Then some spirits were got to keep the heart-action up, which by this time had almost ceased. Before this the mother felt sure the child was dying, and was nearly frantic with the idea. Hot brandy and water was given in a teaspoon every few minutes, and the case was watched with no little anxiety. She had not been in the pack over fifteen minutes before improvement became apparent. The dark rings round the eyes were less marked, the eyes themselves brighter and less sunk, and the blue and green tints less ghastly. Our hopes began to revive, and our fears to lose their terror. In five minutes more the improvement became so decided that with great gratitude I felt that the novel plan was a grand success, and the danger over. She now became conscious, and, evidently feeling the benefit of the spirit stimulus, asked occasionally for her "toddy," which she, knowing as much about it as she did of snakes and bulldogs, called "vinegar and milk." As the need and benefit of it grew less, she liked it less, and finally refused it. After something over an hour, we took her out of the pack, and were delighted to see that all the swelling, blotches, stiffness, and discoloration had completely disappeared, and Amy was herself again. She was now washed down in cool water, to close the pores and prevent catching cold, and put to bed as usual. She was left with strict injunctions that I should be called up if anything went wrong during the night, but my sleep was not disturbed. Next morning I went to see my little patient, and found her at the breakfast table, with as good an appetite as ever. After that we can excuse the mother for thinking that the hot sweating-pack was the panacea for "all the ills that flesh is heir to."

But some will ask, Why call this a case of snake-bite? When she recovered, we questioned her as to the size and appearance of the "bulldog," and she described it as "a big, long, pretty thing." When asked how many legs it had, she said, "No legs; a big pretty thing, as long as my arm, all shiny." But evidence still more definite was at hand. A few days after, the father, who was up-country at the time of the occurrence, sank a well near where she had fallen, and where there was a lot of long grass and loose timber, and, having struck water, stopped for a rest and a cup of tea. When he returned, a black snake (*Pseudechys porphyraicus*), having smelt the water, was down in the well. He came to tell me that he thought he had caught Amy's bulldog. Then we took her to the well without telling her anything of what was in it, and asked her if she had ever seen a thing like that; and directly she saw it she said, "Yes, that's the bulldog that bit me."

Of course the ligature-cut-and-suck method is best when applied in time, and when the bitten spot is known; but it would be utterly useless in such a case as this, where the poison had already been carried all over the body. The method here advocated would be applicable, I believe, to almost all cases of poisoning that had reached the same stage, whether from snakes, spiders, scorpions, insects, and such like, or from poisons taken by the mouth, whether drunk as liquids or eaten as poisonous fish, etc.; and I have no doubt would save many a valuable life after the venom had got too far through the system for local sucking, or even the stomach-pump, to be of any avail.

ON THE INTRODUCTION OF THE EUROPEAN BARK-BEETLE-DESTROYER (CLERUS FORMICARIUS L.) TO AMERICA.

BY CAMILLO F. SCHAUFUSS, DIRECTOR, MUSEUM LUDWIG SALVATOR, MEISSEN, GERMANY.

DIE forstlichen Verhältnisse Europas und Amerikas sind durchaus verschieden:

In dem alten Europa — wir haben hier also die älteren Culturstaaten, namentlich Mitteleuropa, im Auge — finden wir eine Jahrhunderte alte, rationelle Forstbewirthschaftung durch akademisch gebildete, fachkundige Männer, infolgedessen, was uns als erste Vorbedingung für einen *geordneten* Waldbau erscheint, ein vorzügliches Strassenwesen innerhalb der Forsten. Damit ist ein leichter und billiger Transport der geschlagenen Bäume vorhanden.

In dem jungen Amerika haben wir noch grosse Strecken ganz jungfräulichen Gebietes, sonst grossentheils eine verhältnissmässig junge, ja, wohl *sehr* junge Forstwirthschaft; infolgedessen ein noch ungenügend entwickeltes oder unentwickeltes Strassenwesen innerhalb der Forsten, und damit eine schwere und theure Abfuhr der Hölzer.

In Europa ferner: eine dichte Bevölkerung, mithin ein flotter Absatz für das Holz, Rinden und Zweige *an Ort und Stelle*.

In Amerika: eine dünngesäete Bevölkerung, also Mangel an Absatz, langer und kostspieliger Transport der Baumstämme bis zum Verkaufsplatze, während die Wipfel und Zweige der Bäume wegen der ungenügenden Wege und theuren Fortschaffung meist im Walde liegengelassen werden müssen.

Es ist unter diesen Umständen gar nicht möglich, gegen auftretende Waldverwüster, wie solche die Insektenwelt in so grosser Zahl stellt, mit den, beispielsweise in dem forstlich hochentwickelten Deutschland üblichen, *radicalen* Vertilgungsmaassregeln vorzugehen, auf welche einen Blick zu werfen wir uns für einen späteren Aufsatz vorbehalten.

Nun hat die Natur fürsorglich gar wohl darauf gesehen, dass in ihrem Haushalte das Gleichgewicht erhalten bleibe; sie hat deshalb auch dem Ueberhandnehmen der einzelnen Thiere ein Ziel gesetzt, indem sie ihnen Feinde zugesellte. So haben besonders die Insekten, ausser den Vögeln, sehr viele Nachsteller unter ihresgleichen. Da ist die grosse Zahl der Raubinsekten aller Ordnungen, welche als Strassenräuber über alle Kerfe herfallen; dann giebt es besondere Feinschmecker, die sich nur an eine Fleischsorte halten, deshalb allenthalben mit ihrem Nahrungsthiere zusammen vorkommen; und endlich die heimtückischen Schleicher, die entozoischen Parasiten, welche in so grosser Zahl unter den Hymenopteren und Dipteren sich finden.

Bei der Natur ging der Forstmann in die Lehre. Ratzeburg,[1] der grosse bahnbrechende deutsche Forstentomologe, berichtet von 1868 in Posen (Preussen) vorgenommenen Versuchen mit Uebertragung von Maulwürfen auf von Engerlingen (Larve des Maikäfers) bedrohte Kulturflächen, Versuchen, die nicht ohne Erfolg blieben. Weiter hat derselbe Gelehrte die Waldameise (Formica rufa)[2], sowie Schlupfwespen nach von Schmetterlingsraupen heimgesuchten Gegenden übertragen, und andere Fachmänner sind seinem Beispiele gefolgt. In neuster Zeit hat namentlich C. V. Riley, soviel ich gehört habe, wiederholt Experimente mit der Translocation von Schlupfwespen gemacht.

Wie im July dieses Jahres Mr. Andrew D. Hopkins von der West Virginia Agricultural Experiment Station in Morgantown den Lesern unseres Blattes mittheilte[3], ist in den letzten Jahren in West Virginia der Borkenkäfer, Dendroctonus frontalis Zimm., in solchen Unmassen aufgetreten, dass auf einem Raume von 10,000 square miles 75% aller Nadelbäume krankten oder abstarben.[4] Der genannte Staat gehört aber zu denjenigen, wo eine rationelle Waldkultur, mithin eine rationelle Vertilgung des Borkenkäfers noch nicht möglich ist. Mr. Hopkins fasste deshalb den Gedanken, um wenigstens zu thun, was möglich ist, um dem Waldfeinde entgegenzutreten, nachdem er beobachtet hatte, wie Clerus dubius F. sich alle Mühe gab, mit den Scolytiden aufzuräumen, ihm einen Helfer in seinem guten Werke zur Seite zu stellen.

Europa und Nordamerika haben seit langer Zeit, wie dies der rege Verkehr zwischen beiden Erdtheilen und die Gleichartigkeit des Klimas mit sich bringt, gegenseitig ihre Schädlinge ausgetauscht: ich erinnere an den Kartoffelkäfer (Leptinotarsa decimlineata Say) in Deutschland und an den Kohlweissling

[1] Ratzeburg, Die Waldverderber, 1841, pp. 21, 22.

[2] Ratzeburg, Die Waldverderbniss, 1868, II., p. 429.

[3] Science, Vol. XX., No. 495.

[4] Dies wird erklärlich, wenn man die beträchtliche Fruchtbarkeit der Scolytiden kennt. In der Mitteleuropäischen Forstinsektenkunde stellen hierüber Judeich und Nitzsche folgendes Rechenexempel auf: Nehmen wir an, ein Mitte April fliegendes Weibchen habe in seinem Muttergange 90 Eier abgelegt, so können wir mit Sicherheit darauf rechnen, dass im Anfang Juni wenigstens 30 Stück davon zu fortpflanzungsfähigen und wirklich begatteten Weibchen sich entwickeln. Legt jedes dieser 30 Weibchen wieder einen Muttergang mit 90 Eiern an, so produciren sie also zusammen 2700 Stück, und wird Anfang August beim dritten Fluge wieder nur ein Drittel davon zu Weibchen, so nagen diese schon 900 Muttergänge und belegen sie mit 8100 Eiern. Gelangt von diesen wieder nur ein Drittel im nächsten Frühjahre zum Eierlegen, so kommen im April bereits 27,000 Nachkommen des *einen* im vorhergehenden April geflogenen Weibchens zur Fortpflanzung und können nun 2,430,000 Eier ablegen!

(Pieris brassicae L) in den Vereinigten Staaten. Warum also nicht auch die Nützlinge?

Mr. A. D. Hopkins that wohl sehr gut, sein Augenmerk auf Europa zu richten.

Und in der That haben wir in Clerus formicarius L. einen Käfer, der nicht nur in seinem Aeusseren, in Grösse und Färbung, seinem amerikanischen Bruder, Clerus dubius F., überaus ähnelt, sondern dem Letzteren auch in seinen Lebensgewohnheiten gleicht. Er ist, sowohl als Larve, wie als Imago, ein scharfer Feind der Nadelholz-Borkenkäfer, gleichviel ob sie auf Kiefer oder Tanne leben, und dabei recht zahlreich.

Diesen wählte Mr. Hopkins zur Einführung nach Amerika.

Um sein Ziel sicher zu erreichen, setzte er sich mit dem durch seine klassische Monographie berühmten Scolytiden-Specialisten Eichhoff und mit mir in Verbindung und kam im August nach Europa, hier die Lebensbedingungen des Thieres zu studiren und zu sammeln.

Mr. Eichhoff schrieb mir, während Herr Hopkins im Elsass sammelte, dass derselbe "mit seltenem Geschick und grossem Glück" arbeite, und ich selbst konnte dies sehr bald aus eigener Anschauung bestätigen, als ich mit Mr. Hopkins gemeinschaftlich mehrere Tage in den sächsischen Wäldern auf Cleriden fahndete. Wir fanden die Larve in allen Stadien des Wachsthumes, die Puppe, die eben entschlüpfte Imago, und den kräftigen, lebhaften Käfer in ihrem kunstvollen Winterquartieren innerhalb der Rinde.

So kann denn Mr. Hopkins zufrieden auf den Erfolg seiner Reise blicken, denn er nahm eine stattliche Zahl Cleriden in allen Stadien, der Sicherheit halber in vertchiedener Weise verpackt, mit nach Hause. Und da es wohl keinem Zweifel unterliegt, dass der weitaus grössere Theil der in der Winterruhe befindlichen Thiere gesund ankommt,—wenn nicht übertriebene Cholerafurcht etwa Herrn Hopkins Schätze durch Disinfection verdirbt,—so kann im Frühjahre mit dem Acclimatisationsversuche begonnen werden.

Für genugenden Nachschub wird von mir eventuell gesorgt werden, um Mr. Hopkins's Experiment gelingen zu lassen.

COLIAS EDUSA AND COLIAS HYALE.

BY A. HEATH, LONDON, ENGLAND.

GREAT BRITAIN this year has been favored with an abundance of these beautiful insects; from every part come reports of innumerable captures, especially of *C. Edusa*, many insects being taken at one throw of the net. *C. Hyale* has also been, I may say, plentiful when we consider its comparative rarity here; friends of mine report taking during a few days as many as four or six this season. I have myself taken four fine specimens in as many days. The first specimen I took in June, but it was the only example of *Colias* that I saw until August; as a rule these insects are never taken in England until August. In 1886 we had a similar year; enormous numbers of *C. edusa* were to be seen, one entomological friend told me he had seen a certain field in Kent yellow with them. It seems most extraordinary that this year we should have had such an abundance of this particular insect, when last year scarcely one was to be seen even in their favorite localities.

Some entomologists believe that they come across the English Channel (over 20 miles of water) in swarms, but if this were the case, surely someone would see them arrive or on their arrival before they scattered over the country. Then, if this were so, why do we not get an annual visit in quantity? The insect is always in abundance on the continent of Europe, and there is also an abundance of many other kinds of butterflies that we seldom or never see here. My idea respecting these occasional abundant swarms is that butterflies' eggs are indestructible, and will lie on the ground for years until a favorable season arrives.

The eggs of *Colias* are laid on the food-plant, various forms of *Trifolium*; this is not only their food, but the food of every kind of four-footed animal, domestic and otherwise, inhabiting this country (except carnivora), and the whole field or crop of *Trifolium* is eaten either in a green or dry state. What, then, becomes of the eggs deposited? They must be eaten up almost entirely, and if not indestructible they would be destroyed. This seems not to be the case, and it is probable that they can pass through the animal uninjured by the heat of its body, and so be again distributed over the ground. Without some such theory it seems almost impossible to account for the large numbers found in a cultivated country following a year of scarcity like last year, especially when we remember the enormous number of larvæ destroyed by ichneumon and other countless enemies, bad seasons, etc.

NOTES AND NEWS.

THE New York Academy of Sciences has recently organized a biological section which will hold monthly meetings. At the opening meeting, Oct. 17, Professor Henry F. Osborn acted as chairman. The following papers were presented. Bashford Dean, "On Dionæa under its Native Conditions near Wilmington, N.C.," the results of experiments emphasizing the plant's erratic sensibility and its special adaptability for capturing ground insects; N. L. Britton, "On a species of Hieracium;" E. B. Wilson, "On the Artificial Production of Twins and Multiple Embryos in Amphioxus." The paper dealt mainly with the peculiarities of double monsters produced (as in Driesch's experiments on Echinus) by shaking apart the blastomeres of two- and four-celled stages (*v. Anatomischer Anzeiger*, 1892). Every gradation exists between two perfect and separate bodies, each half the normal size, and four in which the only indication of duality consists of a bilobed condition of the archenteron. In the double gastrulas the long axes of the two halves may form any angle with each other, and the two blastopores when separate may be turned in any direction. In cases where the two blastopores face each other, the two bodies are united by a bridge of tissue at one side, essentially as in the double gastrulas of certain earthworms.

— As cotton-seed meal is gradually coming into use in Ohio as a valuable adjunct to the ration for dairy cows, and as the scarcity and consequent high price of corn the present season may tempt some farmers to add this meal to the pig ration, it seems advisable to call attention to bulletin 21 of the Texas experiment station (located at the Agricultural and Mechanical College of Texas, College Station P. O.). In this bulletin Director G. D. Curtis reports the results of a long series of experiments in feeding cotton-seed to pigs, from which he comes to the conclusion that there is no profit whatever in feeding cotton-seed in any form to pigs, whether the seed be boiled, roasted, or ground. The ground seed seems to have produced the worst results, causing the death within six to eight weeks of a large proportion of the pigs to which it was fed, and especially of the medium and small-sized shoats. The boiled seed was less injurious, but roasted seed was almost as fatal as the meal. These pigs were fed alongside of similar pigs which had corn instead of cotton-seed, and the corn-fed pigs remained in perfect health. The symptoms produced by the cotton-seed are described as follows: The first sign of sickness, appearing in from six to eight weeks after cotton-seed meal is added to the ration, is a moping dullness of the animal, with loss of appetite and tendency to lie apart. Within the course of twelve to thirty-six hours, often within the shorter time, the animal becomes restless; staggering in his gait; breathing labored and spasmodic; bare skin showing reddish inflammation; sight defective, and both the nervous and the muscular systems feeble and abnormal in action. The fatal cases all show "thumps"—spasmodic breathing, and in many instances the animal will turn in one direction only, following a fence, or building wall, so closely as to strike his nose against projections in a vain endeavor to push outward in that one direction which he tries to take. If no fence or building intercept him he may travel in a circle—large or small according to the mildness or acuteness of the malady in his particular case. When exhausted by his efforts the animal drops down suddenly — sometimes flat upon his belly, sometimes dropping on his haunches with his fore legs well apart to keep from falling over — almost always with the evidence of more or less acute internal pain. At death a quantity of bloody foam exudes from mouth and nostrils.

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WHY IS SEA-WATER SALT?

BY W. MATTIEU WILLIAMS, F.R.A.S., F.C.S., LONDON, ENGLAND.

THIS question has been regarded as a mystery and has given rise to some curious speculations, but a little consideration of the subject must, I think, satisfy us all that it would be very wonderful, quite incomprehensible, if the waters of the ocean were otherwise than salt as they are.

The following explanation was first suggested to myself many years ago when receiving my first lessons in practical chemical analysis. The problem then to be solved was the separation of the bases dissolved in water by precipitating them, one by one, in a solid condition; filtering away the water from the first, then from this filtrate precipitating the second, and so on, until all were separated or accounted for.

But in doing this there was one base that was always left to the last, on account of the difficulty of combining it with any acid that would form a solid compound, a difficulty so great that its presence was determined by a different method. This base is soda, the predominating base of sea-salt, where it is combined with hydrochloric acid. Not only is soda the most soluble of all the mineral bases, but the mineral acid with which it is combined forms a remarkably soluble series of salts, the chlorides. Thus the primary fact concerning the salinity of sea-water is that it has selected from among the stable chemical elements the two which form the most soluble compounds. Among the earthy bases is one which is exceptionally soluble,— that is, magnesia,— and this stands next to soda in its abundance in sea-water.

Modern research has shown that the ocean contains in solution nearly every element that exists upon the earth, and that these elements exist in the water in proportions nearly corresponding to the mean solubility of their various compounds. Thus gold and silver and most of the other heavy metals are found to exist there. Sonnenstadt found about 14 grains of gold to the ton of sea-water, or a dollar's worth in less than two tons.

As the ocean covers all the lower valleys of the earth, it receives all the drainage from the whole of the exposed land. This drainage is the rain-water that has fallen upon this exposed surface, has flowed down its superficial slopes, or has sunk into porous land, and descended under-ground. In either case the water must dissolve and carry with it any soluble matter that it meets, the quantity of solid matter which is thus appropriated being proportionate to its solubility and the extent of its exposure to the solvent. Rain when it falls upon the earth is distilled water nearly pure (its small impurities being what it obtains from the air), but river-water when it reaches the ocean contains measurable quantities of dissolved mineral and vegetable matter. These small contributions are ever pouring in and ever accumulating. This continual addition of dissolved mineral salts without any corresponding abstraction by evaporation has been going on ever since the surface of the earth has consisted of land and water.

An examination of the composition of other bodies of water, which, like the ocean, receive rivers or rivulets and have no other outlet than that afforded by evaporation, confirms this view. All of these are more or less saline, many of them more so than the ocean itself. On the great Table Land of Asia, "the roof of the world," there is a multitude of small lakes which receive the waters of the rivers and rivulets of that region and have no outlet to the ocean. On a map they appear like bags with a string attached, the bag being the lake and the string the river. All these lakes are saline, many of them excessively so, simply because they are ever receiving river-water of slight salinity and ever giving off vapor which has no salinity at all. There is no wash through these lakes as in the great American lakes or those of Constance, Geneva, etc.

The Sea of Aral and the Caspian are lakes without any other outlet than evaporation, and they are saline accordingly. The Dead Sea, which receives the Jordan at one end and a multitude of minor rivers and rivulets at its other end and sides, is a noted example of extreme salinity. It is, as everybody knows, a sea or lake of brine. The total area of land draining into the great ocean does not exceed one-fourth of its own area, while the Dead Sea receives the drainage and soluble matter of an area above twenty times greater than its own, and thus it fulfils the demand of the above-stated theory by having far greater salinity than has the great ocean.

According to this view the salinity of the ocean must be steadily though very slowly increasing, and there must be slowly proceeding a corresponding adaptation or evolution among its inhabitants, both animal and vegetable. The study of this subject and the effect which the increasing salinity of the past must have had upon the progressive modifications of organic life displayed by fossils is, I think, worthy of more attention than it has hitherto received from palæontologists.

THE ENERGY-FUNCTION OF THE MAGNETIC CIRCUIT.

BY CHAS. P. STEINMETZ.

IN designing alternate-current electric motors, in October, 1890, I was confronted by the problem, to calculate the loss of energy caused by the reversals of magnetism in the iron of the motor-field. At that time very little was known on this phenomenon besides a few experimental data of Ewing. From these data mathematical analysis yielded the result that the loss of energy (by conversion into heat) during a complete cycle of magnetization is proportional to the 1.6 power of the intensity of magnetization, or magnetic induction, B; that is, can be expressed by the formula: —

$$H = \eta\, B,^{1.6}$$

where H is the loss of energy per magnetic cycle, and η a "co-efficient of hysteresis." This result was published in the *Electrical Engineer*, New York, December, 1890.

But it was not quite satisfactory, in so far as Ewing's determinations were made by the magnetometer method, with very slow cyclic variations of magnetism, and it was doubtful whether for very quick cycles, as they take place under the influence of an alternate-current of 100 or more complete periods per second. the same law holds, and especially the co-efficient of hysteresis, η, is the same.

A great number of tests, made during the year 1891, partly by the three-electrodynamometer method, partly by the use of the Eickemeyer differential magnetometer, and published in a paper read before the American Institute of Electrical Engineers, January, 1892, proved that up to over 200 complete magnetic cycles per second the loss of energy per cycle — by conversion into heat — is constant and independent of the number of cycles per second, following the law of the 1.6 power; while, when under the influence of the alternating magnetism, Foucault — or eddy — cur-

rents are induced in the iron, the energy-function of the magnetic circuit follows the more general law:—

$$H = \eta B^{1.6} + \epsilon N B^2,$$

where H gives the loss of energy per cycle and cm^3, in absolute units, N is the frequency, or number of cycles per second, η the co-efficient of molecular friction or hysteresis, and ϵ a co-efficient of eddy currents.

Herefrom the loss of power per cm^3 of iron, in Watts, is derived, as

$$W = NH \times 10^{-7} = \left(\eta N B^{1.6} + \epsilon N^2 B^2\right) \times 10^{-7}$$

The next problem was now, to determine the energy-function of the magnetic circuit for cyclic variations of magnetism between any two limits, B_1 and B_2, and to derive numerical values of the co-efficient of molecular friction, η, for different magnetic materials.

In the meantime, it had been found by Kennelly (Transactions of American Institute of Electrical Engineers, October, 1891) that Fröhlich's formula of magnetic induction —

$$B = \frac{H}{a + bH}$$

(where H is the magnetomotive force or field-intensity, a and b constants), which had been abandoned already as inexact, holds rigidly by a slight modification. Using not the whole magnetic induction, B, but the "metallic-magnetic induction," $L = B - H$, where H is the field-intensity, we find, that for infinitely large field-intensities H, the metallic induction L approaches a finite limiting value L_∞, and follows Fröhlich's formula:—

$$L = \frac{H}{a + \sigma H},$$

or, if we assume Ohm's Law for the magnetic circuit,

$$L = \frac{H}{\rho},$$

where ρ is the magnetic resistance, or reluctance, it is

$$\rho = a + \sigma H;$$

that is, the magnetic resistance is a linear function of the field-intensity.

On the hand of a large number of experimental determinations, made by the electro dynamometer and by the magnetometer method, comprising several thousands of readings, I was enabled to communicate to the American Institute of Electrical Engineers at the meeting of September, 1892, the results:—

1. The loss of energy by molecular-magnetic friction, per cycle and cm^3, for a cyclic variation of the magnetic induction between the limiting values L_1 and L_2, is expressed by the function —

$$H = \eta \left(\frac{L_1 - L_2}{2}\right)^{1.6}$$

where L_1 and L_2 most likely have to represent the metallic induction $L = B - H$.

When Foucault — or eddy — currents are present in the iron, the energy-function of the magnetic circuit takes the more general form —

$$H = \eta \left(\frac{L_1 - L_2}{2}\right)^{1.6} + \epsilon N \left(\frac{B_1 - B_2}{2}\right)^2$$

where the first term gives the energy converted into heat per cycle and cm^3 by true molecular friction, the last term the energy converted into heat by Foucault currents.

2. Beyond a minimum value of field-intensity, Hm, the metallic magnetic resistance follows the linear law:—

$$\rho = a + \sigma H.$$

3. Beyond this minimum value of field-intensity, Hm, all the essential properties of magnetic materials can be expressed by three constants:—

a, the co-efficient of magnetic hardness;
σ, " " " " saturation;
η, " " " " hysteresis;

or, instead of this, by the three constants:—

$L_\infty = \frac{1}{\sigma}$, the value of absolute (metallic) magnetic saturation.

$H_0 = \frac{a}{\sigma}$, the critical field-intensity, or that field intensity where half-saturation, $\frac{L_\infty}{2}$, would be reached, if the linear law of magnetic resistance held already for this field-intensity H_0, and

$H_\infty = \eta L_\infty^{1.6}$, the maximum value of hysteretic loss, by means of the formulas:—

The equations of magnetic resistance, or reluctance—

$$\rho = a + \sigma H = \frac{H_0 + H}{L_\infty}$$

(corresponding to Ohm's Law in the electric circuit), and the energy-function—

$$H = \eta \left(\frac{L_1 - L_2}{2}\right)^{1.6} = H_\infty \left(\frac{L_1 - L_2}{2 L_\infty}\right)^{1.6}$$

(corresponding to the energy-function of the electric circuit, $W = c^2 R$).

4. These equations hold for all kinds of iron and steel, for nickel, cobalt, and magnetite, and most likely for the amalgams of iron, that is, for all magnetic materials.

5. In first approximation, the magnetic induction, B, and the magnetic hysteresis, or molecular friction, H, depend upon the magnetic field-intensity, H, by the law of probability of molecular distances.

6. Average values of magnetic constants are:—

For wrought-iron, soft cast-steel, and mitis metal—

$a = .38 \times 10^{-3}$ $\sigma = .055 \times 10^{-3}$ $\eta = .0036$ $(Hm = 9)$;

for cast-iron and low-permeability cast-steel—

$a = 3 \times 10^{-3}$ $\sigma = .095 \times 10^{-3}$ $\eta = .018$ $(Hm = 22)$;

for soft welded-steel and medium-hard cast-steel of high permeability—

$a = 1.7 \times 10^{-3}$ $\sigma = .06 \times 10^{-3}$ $\eta = .02$ $(Hm = 50)$;

for glass-hard steel—

$a = 10 \times 10^{-3}$ $\sigma = .1 \times 10^{-3}$ $\eta = .07$ $(Hm = 110)$.

October, 1892.

THE APPARENT GROWTH OF GOLD.

BY RICHARD EAMES, JR., M.E.

OF the many myths prevalent regarding gold, the greatest one of all is its growth. Of course there are many interesting instances where ancient worked-out galleries in mines are slowly closing up by the incrustation process, so that space long ago excavated is being filled with an accumulation resulting from the percolation of water through the adjacent wall-rock. This water has in chemical combination such minerals as iron, copper, sulphur, and the precious metals, which are deposited in the open crevice, making for a second time a mineralized body which will show by analysis the above named and many more minerals. In fact, I have had this actual experience resultant on the examination of an old gold mine in Honduras, Central America, that had been worked some time prior to any history we have of that country. This circumstance gave to the natives the idea that gold grew, and they so expressed themselves; while it seemed in the case of one individual a transmutation idea had permeated his head, for he explained that the green carbonate of copper was undergoing a change into silver, while the silver in turn would develop into gold.

In India I found a caste of mining people who believed that gold grew in the bottom of the large lakes situated in that country. They expressed no practical reason other than fairy-tale superstitions. And even in this country there are converts to the idea. I was much amused and interested some years ago to hear an intelligent acquaintance maintain in strong and not altogether religious terms that "the stuff grew and he knew it." His experience was based on the fact that in a certain pile of tailings, resulting from the milling of heavy sulphuretted gold-ores, he had treated at one time several tons with no result. Again, in

three years time he discovered by a pan-test that the same pile had gold in it, whereupon he treated several tons with the approximate result of one dollar per ton. After this last treatment he declared the tailings were barren of gold so far as he could detect by the mechanical means at hand. In order to convince him I selected an average sample, which on assay gave 2 pennyweights, 20 grains gold per 2,000-pound ton. This was considered not worth the working. But my friend maintained that the gold would grow again in two or three years.

True to his word, in two years he was at the pile again, and by his crude but sure method was saving one dollar per ton from the ore that would yield *nil* by his methods two years before. Again, I took samples for assay and was somewhat surprised to find the value had increased just 50 per cent, as the result of my determination was 5 pennyweights, 16 grains per ton. On investigation, I found the sulphurets to be of a character readily decomposed by the elements; in fact to such an extent that, as I afterwards calculated, over one-half of the pile must have been decomposed or washed away, so that with the decomposition a certain rapid concentration was maintained by the action of heavy rains, and the natural advantage this particular ground offered causing the gold to remain behind while the oxides were carried away in suspension by the water. My explanation has failed to convince my friend of the pick and shovel. As the gold in the tailings has become about exhausted, his last attempt to make pay was a failure. He remains strong in the conviction that a few years will grow it again.

Gold Hill, North Carolina, October, 1892.

CURRENT NOTES ON ANTHROPOLOGY.—XVIII.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The Early Age of Metals in Europe.

As has been previously remarked in these Notes, there is a growing tendency in European archæology to rate the civilization of Europe at the dawn of the historic period decidedly higher than has been heretofore supposed, and to regard it more and more of indigenous development. Those old theories which attributed pretty much all that deserved the name of culture to Asiatic or Egyptian sources are diminishing in favor.

An instance of this is seen in an article by M. Salomon Reinach in *L'Anthropologie*, 1892, No. 3, in which he discusses with his accustomed wealth of erudition the derivation of the name "Cassiterides," and with it the origin of tin and bronze in western Europe. He claims that this name is of Celtic origin, and means "Remote," or something of that kind. It was applied by the Gauls to the portion of western England whence came the tin. This conclusion proves several points, if once accepted. As Homer talks of the Cassiterides, it shows that before his time the tribes of western France spoke Celtic; that they worked in and exported metals; and it gives room to inquire whether one of the centres of the discovery of bronze was not in western Europe.

Other archæologists of ability, such as Franz von Pulszky, in the *Archiv für Anthropologie*, Bd., XX., have called attention to the fact that the specific civilization of the Celts was higher than is generally recognized. Their heavy iron swords, for striking, not thrusting, their ornamentation, derived from the circle and the triangle, and their use of torques, wound metal neck-rings, reveal positive ethnic art-capacity. Their presence in Hungary is well marked by such remains in the tombs of an early epoch.

Figurines of the Stone Age.

The glyptic art goes back far into the stone age, far even into the old or rough stone age. In the *Antiqua* for 1887–1890, R. Ferrer has discussed and depicted the earliest human statuettes from the European bronze and stone ages. The oldest always represent the individual naked, and the parts of sex very prominent. This is also the case with the Phœnician bronze figurines from Ellora, in Portugal, while those from the north are clothed.

Last December there were found some interesting remains near Brunn, Germany, at a depth of four and a half meters, amid bones of the mammoth, rhinoceros, and reindeer. They were a human skull, and adjacent to it a human figurine 20 centimeters high, carved from the tooth of a mammoth, and bored through, evidently for the purpose of suspension. The figure is naked and prominently masculine, though the mammæ are clearly represented.

The skull presented an index of 65.68, and was therefore singularly dolichocephalic; its estimated cubical capacity was 1,350 cubic centimeters; it was not prognathic, but the frontal sinuses were very prominent, and the glabella also, thus presenting an inferior character.

When the head of the figurine is regarded in profile, it presents this peculiar appearance of prominence in the glabellar region, thus showing that it was carved to imitate the then prevailing type of humanity.

These and other interesting facts about this noteworthy find are given in the Proceedings of the Niederrheinische Gesellschaft, 1892, by Professor Schaaffhausen of Bonn, who adds an engraving of the skull. Like all his articles, this one is prepared with the most satisfactory care.

The Study of Hair.

The study of the hair on man offers a most extensive field of inquiry, and one which presents many unsolved problems of the first order of importance. Some of these are discussed by F. Lapille in *Le Naturaliste* and by Dr. Bartels in the *Zeitschrift für Ethnologie* of recent dates.

Why man as a species should present the amount and kind of hair that he does is variously explained, and the differences between the varieties of the human race are so great in this respect that, as is well known, one of the most popular subdivisions of the species is founded upon it. Most mammals have more hair than man, but some less, as the Cetaceæ and the Sirenidæ. The anthropoid apes have, as a rule, much hair where man has little, as in the arm-pits and around the sex-organs. In some localities, as the ears and nose, the hairs are clearly protective organs, while around the genitals they appear to be merely ornamental. In monkeys, the females are bearded, but such examples are rare in the human species. Bearded women, however, are not otherwise masculine, but have the sentiments and the capacity for motherhood. Bartels describes a very hairy Gypsy girl, only seventeen years old, but already the mother of three children. With her the hairiness was from a naevus pigmentosus of extraordinary extent; and why these naevi should develop hairs is worth inquiry. Man has the longest hair of any animal, and why he lost it over most of his body is the subject of much curious speculation. The loss led him to the inventions of painting and tattooing his body, of covering it with clay or clothes, to depilation, to the sense of modesty, and to many other unexpected results. The history of hair in man is thus an extraordinary one for the evolution of the species.

On Quarry-Rejects.

For two or three years past there has been in the air — I mean the air which archæologists breathe — a low but menacing sound, threatening some dear theories and tall structures, built, if not on sand, at least on gravels offering a scarcely more secure foundation.

These menaces bear more directly on what is classically known as the "old stone age," that of chipped implements, and particularly on that period of it which is alleged to be characterized by very rude — and which are therefore supposed to be very old — types. The new views come from a study of the aboriginal quarries, the sites where the ancient tribes collected the materials which later and at other localities they worked up into finely chipped or polished implements. This part of the work they did not perform at the quarry; and pieces which after a few test-blows by their skilled hands they saw could not be utilized at all, or only at the cost of considerable labor, they threw aside and left on the spot. These are "quarry-rejects," and after you have handled and studied several hundreds of them you can always see why they were thrown away; you can recognize, as did the aboriginal artist, why they would prove worthless or troublesome in further working.

Now the alarming discovery has been made that a great many of what we have heretofore called "palæolithic implements" display with fatal clearness the peculier earmarks of these "quarry-rejects," hinting, therefore, that they never were real implements at all. What is worse, like the rejects, they show no signs of use, and clearly never could have been employed as implements, and consequently do not in any way illustrate the industry of the chippers, no matter of what age they are. If found in gravels, the gravel-bed was the quarry, and they the refuse. It has even been hinted that the famed gravels of the Somme and the "palæolithic floors" of the Thames and the "Trenton gravels" of our own land, may have to lose their laurels in the light of this discovery.

The Builders of the Southern Mounds.

Those who have looked at the archæological collections of the Smithsonian with any attention, cannot fail to remember the extraordinary specimens of copper work from the Etowah valley mounds, in northern Georgia. The figures they delineate have an unquestionable family resemblance with those inscribed on shells obtained on the lower Mississippi, so accurately presented in Mr. Holmes's essay in the Report of the Bureau of Ethnology, 1880–81. Both present curious analogies to Mexican and Maya art, and I have been almost constrained to believe in a connection, either ethnic or commercial, between these peoples.

Dr. Eduard Seler, however, who is a most competent authority on these questions, expresses a different opinion in a recent article in *Globus*, Bd. LXII., No. 11. He analyzes with care the mode of wearing the hair, the headdress, the clothing, and the weapons of the figures, and shows that in several of these points they correspond with the descriptions of the early voyagers of the natives they found in these localities. He also compares the same features with similar relics from ancient mounds in the Ohio valley. The conclusions he reaches are, that the builders of the Etowah mounds and the artists of the inscribed shells were probably related to the builders of the Ohio mounds; that they were not the direct ancestors of the tribes found in Georgia at the discovery; that there is not sufficient reason to suppose connection with Mexico or Yucatan; that probably the mound-building and copper-working tribes were destroyed or driven to the remote sea-coast by invasions from the north and west at a period not very remote from that of the discovery of the continent.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

"Ancient Mexican Heraldry."

PERMIT me to place before the readers of *Science* an interesting fact kindly communicated to me on Oct. 17 by the Rev John Woodward, LL.D., F.S.A., the learned author of "A Treatise on Heraldry, British and Foreign," referred to in my article on "Ancient Mexican Heraldry" in *Science*, No. 508, Sept 23. That gentleman has just informed me "that the late Mr. Ellis, in his book on 'The Antiquities of Heraldry,' 1869, made reference to the Armory of the Ancient Mexicans and gave a plate (iv.) of the symbols from the works of Lord Kingsborough and Mr. Stephens." "There is not, however," my courteous correspondent adds, "any evidence that the use of such devices was hereditary; they were, so far as we know, merely personal distinctions" This agrees with the general conclusions, based on special investigations, of Mrs. Zelia Nuttall, who was doubtless, like myself, unaware of the publication of Mr. William Smith-Ellis's views on Mexican heraldic emblems nearly a quarter of a century ago. I endeavored in vain to consult a copy of his work when studying the subject of my communication to *Science;* and, as other students may experience the same difficulty, I will reproduce the Rev. J. Woodward's observations respecting ancient heraldry on page 26 of the Introduction to Vol. I. of his recent Treatise on Heraldry in general.

"Mr. W. G. (*sic*) Ellis, in his 'Antiquities of Heraldry,' has collected a mass of interesting matter relating to what he calls the heraldry of ancient times and of all nations of the world, and he certainly succeeds in showing to how great an extent pictorial symbols, which had originally a meaning, have been in use among all nations of mankind, civilized and savage. His plates are curious as showing the occasional occurrence among these manifold devices of some resembling modern figures of blazon. The crescent, the mullet, the lozenge, the quatrefoil, and the fleur de lis are traced by him to counterparts existing among Egyptian, Chinese, Indian, and Japanese emblems; and among the figures on Etruscan vases he shows us what, in heraldic language, would be called a bull's head caboshed and a not unheraldic-looking demi-boar."

Furthermore, it is noteworthy that the Rev. John Woodward considers "there is some reason to believe that the use of the hereditary badge must have long preceded hereditary heraldry" (p. 589). Additional instances of their use as military distinctions rewarding the capture of prisoners in European warfare may be cited from his interesting work. Two fleur de lis with other "augmentations" were granted to Sir John Clerke because he took captive Louis Duke de Longueville on the field of Therouenne, better known as the battle of the Spurs, and fought a month before the eventful fight of Flodden. A still more interesting case is that of the "Crampet," or metal termination of the scabbard of the sword, sometimes borne as a device. One was assigned to Sir Roger La Warr about the same time as the buckle was granted to Sir John Pelham in recognition of his aid in the capture of King John of France. It is somewhat remarkable that the descendants of these gallant knights, who fought side by side at Poictiers, still hold lands and earldoms in the same County of Sussex. Some members of the ancient house of De la Warr passed over to America in the fifteenth and sixteenth centuries, hence the more familiar name of Delaware. AGNES CRANE.

Brighton, England, Oct. 21.

Reticulated Protoplasm of Pelomyxa.

SINCE the publication of Dr. Stokes's article myself and colleague, Mr. W. F. Pentland, have had several opportunities of examining Pelomyxa Palustris. The difficulties of the investigation are so great that at his suggestion I tabulate the methods and their results.

1. Examination of unstained preparations (50 slides). Utterly useless as far as the detection of reticulation is concerned. 2. After treatment with osmic acid, usually 1 per cent solution, one organism was found destitute to a great extent of ingested material. An $\frac{1}{8}$ Powell and Leland water-immersion and Zeiss 12 compensating occular failed even with critical light, with an immersion condenser, and ammonia sulphate of copper solution as modifier, to detect the slightest trace of reticulation. 3. In the same preparation we found some Amœbæ resembling Proteus. The coarseness of the enclosure in these specimens we found would lead a neophyte astray, as it frequently resembled reticulation. 4. Determined to leave no stone unturned, we tried the usual aniline and carmine dyes, with no result. 5. One-half per cent solution of chloride of gold (no osmic acid) was tried on over twelve slides. I must certainly confess I glimpsed reticulation in two specimens, but owing to the protracted investigation was compelled to desist.

So far with regard to amœbic organisms. It is in the field of pathology that reticulation of protoplasm is most frequently observed, as far as my experience goes. The more rapid the morbid process the greater certainty of reticulation. Fifteen years ago I was working with my lamented colleague, Dr. Bookey of Dublin, on the effects of bichloride of mercury on blood corpuscles; but fortunately we did not follow out Dr. Klein's suggestions to the letter, as we found epithelium cells beautifully reticulated as described by Dr. Stokes. We found the nucleus in the blood discs, but, as usual in scientific investigations, forgot to look for reticulation. However, on a future occasion the late Sir Robert Macdonald submitted to us for examination a portion of tumor of then unknown nature. The portion was placed in Muller's

fluid when sent, and that evening sections were cut and mounted after short treatment with picro-carmine. Without examination two slides were sent to Sir Robert (we were busy on small-pox), who returned them with the remark, "Only muscular fibre."

Dr. Bookey looked at me and I gazed upon him, we then subjected the slide to examination with $\frac{1}{12}$ water-immersion Powell and Leland and No. 2 eye-piece, all apparatus being Powell and Leland. I have seen reticulation since, but in a tumor purely epitheleomatous; it was simply wonderful. The cells were perfectly differentiated, and the reticulation was so regular that we at once forgave Sir Robert for his hasty conclusion.

We hope to continue our investigations on amœboid organisms; but, as the process is so long, my colleague persuaded me to send you these remarks. A. COWLEY MALLEY.

Munslow, England.

The Fundamental Hypotheses of Abstract Dynamics.

I HAVE been prevented from making earlier reference to Mr. Dixon's letter in *Science* of Sept. 9, p. 149, criticising my address on the above topic, *Science*, Aug. 5, p. 71. The letter was especially interesting to me as I had not seen his paper, "On the Logical Foundations of Applied Mathematical Sciences," communicated to the Mathematical Society of London some few months ago.

Mr. Dixon, taking the relativity of direction into account, seems to me to have proved that the Laws of Motion may be regarded as forming a definition of force. My argument to show that if they be so regarded, they are not in general consistent with one another, involved the specification of accelerations by reference to a single point, and thus assumed the possibility of determining directions absolutely. While valid, therefore, as against the writers to whom I referred, who make the same assumption, it has not the more general validity which I supposed.

That I have regarded force as a non-relative conception, while Mr. Dixon has thus shown that it may be regarded as relative, would seem at first sight to place us in antagonism. It does not, however; for I have merely discussed certain points in connection with the laws of motion, employing the ordinary conception of force, and making no inquiry as to the assumptions involved in it, while Mr. Dixon proves that this conception must involve certain assumptions, and seeks to determine what they are.

Mr. Dixon points out that it is the law of the conservation of mechanical energy only which is deducible from the assumption that stresses are functions of the distance between the particles on which they act, and that this law would not include the general law of the conservation of energy until all energy was shown to be mechanical. That is quite true; but it does not seem to affect my contention, that, since we are now so sure of the conservation of all forms of energy that the law of the conservation of mechanical energy is frequently assumed as itself axiomatic, the laws of motion, if they are to be retained as dynamical axioms, should be supplemented in such a way that this law would be deducible from them. Nor does the fact that the law of the conservation of energy is usually expressed at present in a form which is probably temporary seem to me to make this any the less desirable. The conception of potential energy may lose its utility as we gain clearer insight into dynamical phenomena. When that time comes we may have to modify our fundamental hypotheses to suit the clearer views which will have been gained; but in the meantime it seems none the less desirable that we should have axioms sufficient for the deduction of the law of c nservation in its present form.

There is, as Mr. Dixon supposes, an omission in the sentence of my paper which he found unintelligible. If commas be inserted after the words *sum* and *masses*, it will be found to state that, if m_1 and m_2 be the masses of two particles, and a the relative acceleration produced by a stress between them, this stress may be shown to be proportional to

$$a\ m_1\ m_2 \div (m_1 + m_2).$$

It follows that, if one of the particles be of infinite mass, the stress is proportional to the mass of the other multiplied by the relative acceleration. When I conclude from this that "if, in applying the second law of motion, a particle of infinite mass be chosen as point of reference, all the forces acting on a system of particles, may be regarded as exerted upon them by the particle of infinite mass," these forces are supposed to be exerted in accordance with the third law of motion, which asserts action and reaction to be equal and opposite, but not to be in the line joining the particles acting on one another. I do not myself regard this fiction as of any importance. I mentioned it in passing because I wished to refer subsequently to Newcomb's assertion that the law of the conservation of energy assumes it.

Mr. Dixon considers it inconvenient to include in one law of stress two statements resting on such very different evidence as that forces may be considered to be attractions or repulsions and that their magnitudes depend solely on the distances between the particles on which they act. I need hardly say, however, that I see no objection to enunciating the two statements in separate sentences. For educational purposes, indeed, it would certainly be well to enunciate what I have called the law of stress piecemeal, as is invariably done in the case of what I have called the law of force. J. G. MACGREGOR.

Dalhousie College, Halifax, N. S., Oct. 4.

The Libyan Alphabet.

I GLADLY accept Dr. Brinton's offer (*Science*, Sept. 30); only, if his object is truth rather than the scoring of a point, he will place in the editor's hands, not the *Grammaire tamachek*, which would be useless for the purpose, but the *Grammaire kabyle*, which alone contains the full forms of the three Berber alphabets, but which Dr. Brinton appears never to have seen. Even the *Grammaire tamachek*, now that he has got hold of it, he seems incapable of understanding. The other day he mistook diacritical marks for accents, and now he tells us that Hanoteau connects the Libyan and Semitic systems "solely" because both are read from right to left, even charging me with disingenuousness for suppressing this fact. The charge might stand, had I made the assertion, which is as wide of the mark as is Dr. Brinton's appeal to Hanoteau, on the question of accent. The very Berber name *asekkil* (pl. *isekkilen*) of the letters is equated by Hanoteau (p. 5) with the Arabic *shakl* and the Hebrew *sâkal*, "forme, figure, dont les Grecs ont fait σιγλαὶ," hence the French *sigle*. I am not defending these equations, but merely give them to show how ignorant Dr. Brinton still is of the contents of the *Grammaire tamachek*, which he had the temerity to insinuate I had never seen (*Science*, Aug. 19). May I ask Dr. Brinton who are the "French scholars" that regard the initial *t* as radical in the word *tifinar*, and that accent the word differently from Barth, for this also appears to be again insinuated? The recent death of M. E. Renan reminds me that that illustrious "French scholar" is also arrayed against Dr. Brinton, holding that the Punic origin of the Libyan alphabet is an established fact (*Histoire des langues semitiques*, 2d ed., p. 194. *et seq.*). Dr. Brinton is to be envied his possession of "plenty of documents in *tifinar*." Such documents are excessively rare in Europe, and even amongst the Tuaregs themselves, who, apart from rock inscriptions, have never made any extensive use of this old and defective script. Considering the weakness of his position, Dr. Brinton shows as much want of tact as of bad taste in charging his opponent with lack of candor. A. H. KEANE.

79 Broadhurst Gardens, South Hampstead, N. W.

Is There a Sense of Direction?

IN his article on the "Sense of Direction," in *Science* of Oct. 7, Dr. Work says, "It is very well known that an unguided horse returning to familiar haunts will do so over the same route by which he left them, rather than in a direct line by sense of direction." An incident which came under my observation some six years ago directly contradicts this theory. My father had purchased a very intelligent mare about a month before, and on this occasion I hitched her single to a carriage, and drove to a town about fourteen miles distant. As the direction was almost due north-west, the road ran alternately west and north, there being about eight corners to turn. Although the mare might have been

through the same region before, it is pretty certain that she had never travelled just the same road. Coming back I gave her her head, and she made every turn so as to keep the same road as on the going trip, with one exception. In that case she made a short-cut by a diagonal road across a quarter-section, striking the regular road a mile further on, and saving about a quarter of a mile. In going up I should have taken the same route, had I not had some business which required me to go the longer way. At the point where this road turned off, it led toward a hill which concealed its junction with the regular road. I certainly did nothing to guide the mare, and was astonished to see her take the short-cut.

As Dr. Work has left considerable room for "accident," he may be able to dispose of this circumstance in that way, though I can scarcely accept such an explanation. J. M. ALDRICH.

Brookings, S.D.

THAT the sense of direction is feeble, if indeed present, in civilized man cannot be denied. I have had some experiences which lead me to suspect that it may be obsolescent rather than quite obsolete. It has frequently occurred that in coming into a strange town or city at night, when compelled to abandon all conscious effort to keep my direction, I have found that in some way I had not lost the points of the compass. These may have been happy accidents, but they may have been cases of unconscious orientation.

Again, upon visiting a cave of considerable dimensions, I purposely refrained from any conscious effort in keeping the points of the compass, with the same result as in the preceding cases.

To the foregoing I have added some inquiries, and a few observations upon others, and feel that there is some ground for thinking that there may be a feeble sense of direction still left to us, though so feeble as to be easily overborne by suggestion from the other senses. CHARLES E. BESSEY.

University of Nebraska, Lincoln.

On Biological Nomenclature.

I AM glad to learn, from Dr. Coues's letter in *Science*, that the code of rules promulgated by the American Ornithological Union a few years ago has been rigidly enforced in that branch of biology, and has been found to work admirably in practice. I studied these rules at their appearance with much interest and attention, and have since, so far as possible, endeavored to adhere to them in my own writings, with one exception — that concerning the erection and definition of genera. As I see that the botanists are disposed to accept this same rule, I shall be glad if a wider discussion may be called out before it becomes established. I refer to canon xlii., which recognizes the validity of generic names unaccompanied by definition, if described species are pointed out as types.

Among ornithologists, and perhaps among botanists, such a rule may not be productive of as much confusion and annoyance as is sure to be the case among entomologists. Generic characters are not, and should not be, included in specific descriptions; how then is it possible for the remote student to learn what *nomina nuda* mean, when it is impossible for him to study the types? He who studies only his own immediate fauna or flora, without a knowledge of the allied forms throughout the world, can never be very successful as a systematist, and, if we are to rely upon types, what is the good of a scientific nomenclature? Furthermore, in such a science as entomology, where there is still a tendency to look upon the manufacture of species and genera as the *ultimum bonum* of the systematist, the mere possibility of such a rule obtaining currency must have a tendency to foster superficiality, incompetence, and ignorance. While I do not agree wholly with those who look upon the genus as an abstract thing, over and above types, I do protest strongly against the acceptance of a rule that will relieve the namer from the necessity of knowing anything about the things he names.

The fear of evil results is not a groundless one. Some years ago an Italian writer, with an assurance as boundless as his ignorance, brought forth a new "system" of dipterological classification, with hundreds of new names. Not the slightest attention has ever been paid to his "system;" but, with this rule in force, one would be bound to torture himself in trying to unravel its vagaries. The careless writer should have no such rule, the careful writer needs none. S. W. WILLISTON.

University of Kansas, Oct. 18.

Solid Glycerine.

CAN you inform me, through your magazine, by what chemical, or by what process, glycerine may be solidified, retaining its transparency? Can any reader answer? C. C. SMITH.

New York, Oct. 31.

BOOK-REVIEWS.

Fourteenth Annual Report of the State Board of Health of the State of Connecticut for the Year Ending November 30, 1891. New Haven, 1892.

THIS report presents fresh evidence that the work undertaken by the various State boards of health is steadily increasing both in scope and in value. This encouraging condition of things has been brought about largely by the adherence of several States to the policy of employing competent expert service. The authorities of these States consider that scientific problems can be successfully attacked only by the most advanced scientific methods, and have in consequence availed themselves of the aid of highly trained chemists, biologists and engineers. A great impetus has been given in this way to the best kind of sanitary work.

The Connecticut report contains, besides the usual reports from local boards of health and the annual statistics of births and deaths, several special features of more than ordinary importance and interest. Dr. H. E. Smith presents a special report upon "The Origin of Certain Cases of Typhoid Fever from Money Island." Twenty-one cases of typhoid, one of which proved fatal, were traced to the contaminated water used at a hotel on Money Island. From . . . facts concerning the sources of the water used, it appears that during the period August 11 to 14, at which time all of those subsequently taken ill were at the inn together, the drinking-water was obtained from the billiard-hall cistern." Dr. Smith shows further that abundant opportunity existed for the infection of this particular cistern water, and adduces convincing evidence that the water was actually infected by a case of "walking typhoid," and that the water thus infected spread the disease.

Dr. L. S. DeForest, in his article upon "Tuberculosis as a Local and Contagious Disease in New Haven" discusses the interesting question of infected dwellings. Dr. DeForest found from the data of 1876–1890 three principal districts of concentration of tuberculosis in New Haven. From a detailed study of house cases he arrived at the conclusion that houses sometimes became true foci of infection. "We think that the accompanying maps and tables go far to show that consumption is endemic in certain parts of the city; that in these parts there are many houses in which it is distinctly dangerous to live." The value of Dr. DeForest's interesting paper would be considerably enhanced by the addition of exact references to the writings of Flick, Cornet, and the other workers in this same field.

The report of the "Examination of Certain Connecticut Water Supplies," by Drs. Samuel W. Williston, Herbert E. Smith, and Thomas G. Lee, covers some two hundred pages and is illustrated with a number of well-arranged charts showing the monthly variations of the analyses. In some respects the report merely confirms the previous work of the Massachusetts State Board of Health, but in other respects it improves upon and extends the latter. Fifteen different water supplies were selected for study, and monthly examinations were made of most of these during a period of twenty-three months.

The special report on the chemical examinations is by Dr. Smith, who in his methods follows closely the chemists of the Massachusetts staff. He, however, expresses his results in milligrams per litre rather than in parts per hundred thousand, and makes a few other minor clerical changes. The limited resources at his command did not permit him to take up carefully the interesting and important question of "normal chlorine;" but his chlorine determinations, so far as they go, support the work of

Professor Drown. It is much to be desired that extended and accurate determinations of normal chlorine should be made in all parts of the country. The importance to the water-analyst of such knowledge has been clearly demonstratod by Professor Drown, and there seems no reason why boards of health should fail to take advantage of so useful a key to the purity of a water. Regarding the disagreeable odors and tastes which often arise in waters Dr. Smith coincides with Professor Drown in concluding that these phenomena are rarely due to putrefactive change, but are "the specific odors of certain organisms."

The microscopical examinations were conducted under the charge of Dr. Williston, who used in his work the method devised by Professor Sedgwick, modifying it, however, in more or less important details. Valuable facts are here presented concerning the occurrence and relative abundance of the different groups of small aquatic organisms. A very interesting description is given of the trouble caused in the Meriden reservoir by the Volvox-like Uroglena. An epidemic of Uroglena has since broken out in several Massachusetts water-supplies, and new light upon the history of this obscure and troublesome organism may soon be hoped for. "In conclusion, it may be interesting to observe that on the average about seven thousand plants and animals, aside from the bacteria, are swallowed with every glassful of Connecticut reservoir water that is drank!"

Dr. Lee reports upon the microscopical examination for 1890-91 and also upon the bacteriological examination for the two years covered by the report. The bacterial examination of the reservoir waters reveals some interesting facts. "The periods of greatest number [of bacteria] were principally during the fall months, while the smaller numbers were largely during the summer months." There is a decrease in the numbers in both February and March, the months of melting snow. It is evident that extended and systematic bacterial analyses of this character are still greatly needed, and it is to be hoped not only that Connecticut will enlarge this branch of the work, but that the Massachusetts authorities will find it possible to make an early beginning in this same field.

The specific bacteria commonly found in Connecticut waters were studied by Dr. Charles J. Foote, who describes in this report sixteen forms. The species are not named, and the author says "No attempt at identification has . . . been made, since the data in most cases seemed insufficient to warrant it." This, we think, is a fact to be regretted. The species "XXI.," for example, might perhaps have turned out to be Bacillus janthinus if a few more facts regarding it had been obtained. Attempts to identify, however unsatisfactory in themselves, lead to the accumulation of new data and result in more adequate descriptions. The growth of the different species in gelatin is described with more than usual discrimination, and with the use of several apt comparisons.

A valuable study of the Connecticut River by Dr. Smith concludes the report.

The Hygienic Treatment of Consumption. By M. L. Holbrook, M.D. New York, M. L. Holbrook & Co.

By far the larger part of this book is devoted to the discussion of the prevention and treatment of consumption in its earlier stages. Under this head are given the author's views upon suitable exercises for persons of consumptive tendencies, upon clothing, climate, baths, and other familiar topics. These subjects are in the main handled with common sense and with perhaps more than the usual freshness of illustration.

The author calls attention to the dangerous weakening of the constitution arising from an incessant course of "colds," and gives some sensible practical suggestions for individual hygiene. The connection of colds with indigestion is clearly recognized. "Overloading the stomach with indigestible food is a frequent cause of colds. It is far better to wait a little before eating if one is very tired, or to eat slowly and moderately, so as to give the stomach time to regain its power" (p. 44).

CALENDAR OF SOCIETIES.

Society of Natural History, Boston.

Nov. 2.—George L. Goodale, Certain Aspects of the Vegetation of New Zealand.

Philosophical Society, Washington.

Oct 29—A. W. Harris, Agricultural Experiment Station Exhibit by the Department of Agriculture at the World's Fair; C. D. Walcott, Notes on the Lower Paleozoic Rocks Between the Susquehanna and Potomac Rivers; T. Russell, Relation of Rain-Fall to River Rise; W. Harkness, Flexure of Telescope Tubes.

Publications Received at Editor's Office.

Acland, Sir Henry W. The Inaugural Robert Boyle Lecture. Oxford, Henry Frowde. 12°. Paper. 45 p.

Allen, Harrison. On a New Sub-family of Phyllostome Bats. Washington, Government. 8°. Paper. 7 p.

Bailey, M.A. American Mental Arithmetic. New York, American Book Co. 16°. 160 p. 35 cts.

Baker & Co. Data Concerning Platinum, etc. Newark, Baker & Co. 11 p.

Doughty, Francis F. Evidences of Man in the Drift. New York, Privately Printed. 8°. Paper. 18 p.

Hurst, J. T. Tables and Memoranda for Engineers. 11th ed. New York, Spon & Chamberlain. 182 p. 50 cts.

James, Bushrod W. Alaskana. Philadelphia, Porter & Coates. 12°. 386 p.

Lubbock, Sir John. The Beauties of Nature. New York, Macmillan & Co. 12°. 443 p. $1.50.

Nadaillac, Marquis de. Manners and Monuments of Prehistoric Peoples. Trans. by Nancy Bell. New York, G. P. Putnam's Sons. 8°. 494 p. ill. $3.

Peddie, William. A Manual of Physics. New York, G. P. Putnam's Sons. 12°. 518 p. Ill. $2.50.

Simpson, Charles T. Notes on the Unionidæ of Florida and the Southeastern States. Washington, Government. 8°. Paper. 31 p. Ill.

True, Frederick W. Annotated Catalogue of Mammals Collected by W. L. Abbott. Washington, Government. 8°. Paper. 35 p. Ill.

We question if every one would regard rowing in quite as favorable light as does our author. Paddling in a canoe, which is in many respects a much superior exercise, is unmentioned. Lawn-tennis, also, which is one of the best tools of recreative hygiene, does not find a place in our author's discussion. Horseback riding gets its full due as an admirable form of combined diversion and exercise. Throughout this portion of the book the value of good digestion as an aid to good nutrition is justly insisted upon; and exercise is conservatively regarded as simply a means to the welfare of the whole organism and not as an end in itself.

It seems to us that the author does not emphasize as much as is desirable the means of prevention advocated by many professional bacteriologists. The destruction of tuberculous sputum, if any sort of concerted action can be obtained, will go far towards diminishing the chances of infection. The herding together of the consumptives at "health resorts," and the journeys thither in cars infected by their tuberculous predecessors are raising many serious problems. It will seem to many readers that this side of our author's subject receives inadequate attention.

Physical Education in the Public Schools. By R. ANNA MORRIS. New York, American Book Company.

THIS little manual, designed for the use of teachers in the public schools, is well worth reading by all those who have anything to do with the training of children. It contains a simple yet complete course of instruction in school gymnastics, including a brief description of the Delsartian principles of elocution and expression. The author has not confined herself to any one system of calisthenics, but has selected and adapted the movements of several well-known systems. The exercises have been arranged to cover a period of time included by the kindergarten and succeeding grades through the high-school, and consist of a regular progression of movements.

The principal idea is that of training and not straining the body. Many of the exercises may be taken between the rows of desks, or in the front of the school-room, without the aid of other apparatus than wands, rings, dumb-bells, and clubs. Especial attention is paid to the discussion of the best methods for inducing the correct breathing and carriage of the pupils. The high importance of good ventilation of the school-room is also emphasized. There is included a chapter on temperance-teaching in the public schools, which may give some useful hints.

Finally, a brief course of instruction in reading aloud is outlined, and the manual is completed with a few selections of marches and other music adapted to the accompaniment of the calisthenics. The book contains illustrations and explanatory figures throughout.

AMONG THE PUBLISHERS.

MACMILLAN & Co. announce the issue of a collection of papers by the late Sir Daniel Wilson, entitled "The Lost Atlantis, and Other Ethnographic Studies." It contains essays on Trade and Commerce in the Stone Age, The Æsthetic Faculty in Aboriginal Races, Hybridity and Heredity, etc.

— In the same line as Miss Jordan's "College for Women," published in the last number of the *Atlantic Monthly*, there is in the November number an article by Samuel W. Dike, LL.D., entitled "Sociology in the Higher Education of Women." The author discusses the subject at length, and shows that now the problem is to put the education that young women are getting into its true relation to their future, and to do more to equip the girl for what may be called the great profession of being a woman in her social trinity of wife, mother, and member of society. The many suggestions for the carrying-out of this problem make this paper a valuable one. Among other articles in this number may be mentioned Theodore Bacon's "Some Breton Folk-Songs" and a timely political article, "The Two Programmes of 1892."

SCIENCE

NEW YORK, NOVEMBER 11, 1892.

ARCHÆOLOGY 1880–1892.

BY MRS. S. Y. STEVENSON, MUSEUM OF ARCHÆOLOGY, UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

Egypt—Mr. W. M. Flinders-Petrie.

In the last few years practical archæology has made rapid strides; and — thanks to the increasing number of well-qualified scholars who to-day fill its ranks, as well as to the consequent precision of its improved methods — it not only may now be numbered among the natural sciences, but a general knowledge of its results has become a necessary part of the intellectual outfit of every man who would lay a claim to keeping abreast of the times.

Scarcely a year passes without bringing some new and startling discovery that sheds a vivid flash of light upon some hitherto obscure corner of the remote past. Ancient Egypt, Mesopotamia, Syria, the Mediterranean islands, Asia Minor, the palæolithic and neolithic human strata of pre-historic Europe — all of which, fifty years ago, appeared to the student as isolated reefs, here and there cropping up out of the dark surrounding abyss of time, apparently unconnected with one another, and having but little if any bearing upon our own civilization — are now assuming a new interest. Each is gradually taking its proper place in the great scheme of history; and, in so doing, many of the human fossils, whose dismembered forms, viewed singly, seemed abnormal and fantastic, are resuming their natural aspect. The so-called giants of the past, examined in the light of modern criticism, are shrinking to a normal size; the mythical races have lost their fabulous character; the wild savage has given place in scientific literature to the non-civilized man; the barbarian to the man of low culture; and all have become well-connected links in the long chain of classified human development.

Civilization, in the earliest times as at the present day, has been found to be a sliding scale; and we now know that, in the fourth millennium B.C., as in the nineteenth century A.D., there might be found upon the surface of the globe every grade of culture from the highest, which found expression in the inscribed monuments of Egypt and Chaldea, to that whose remains might be sought among the shell heaps of the far-north.

The pre-Homeric Greeks and the other inhabitants of pre-historic Europe and northern Africa are no longer ignored as little better than savages. As they take their proper place in the history of humanity, Egypt ceases to be spoken of as a "Miracle in Stone;" and — if it still stands pre-eminent among the nations of the ancient world — for the modern scholar it now only represents the crest of the irresistable onward wave that, at a given time, carried human thought to the point where the advancing genius of the Mediterranean races took it up and idealized it, before receding in its turn and leaving its future progress to the peoples of the north.

The recent researches of anthropologists, interpreting the facts furnished by the pre-historic burials of Europe, have everywhere strengthened the view which connects its former inhabitants with the populations of the historical period. Types that once seemed widely different are found to be connected by intermediate ones; and a continuous line, reaching back through ages, has in many instances been formed by the recovery of missing or of hitherto misinterpreted evidence.

As the question now stands, those who would still cling to the hypothesis of Indo-Germanic migrations pouring down into Europe from the plateau of central Asia, must be prepared to face an immense body of facts which they will find equally difficult to get over or to disregard. The theory of the Asiatic "cradle of the Aryans" was originally accepted upon the authority of such eminent philologists as Pott, Lassen, and others; and, despite the early protests of a few scholars (see Dr. D. G. Brinton in *Science*, June 24, 1892), its hypothetical nature was lost sight of and it soon found its way as an undisputed fact into our hand-books and primers. Even to-day — although the word "Aryan," divested of its former meaning, has mainly become a term of philological classification for those who are familiar with the subject, and notwithstanding the arguments to which the use or the misuse of the word has publicly given rise — this curious myth of the nineteenth century still holds the position of an orthodox belief, and is still taught as an article of faith in our schools!

In the face of such facts, and as the results of archæology have a recognized and direct bearing upon many branches of scholarship, it is of serious moment that these results should be published, not only as speedily as possible, but in such a form as to make them available to all.

At present this is rarely the case. As a rule, the labors of archæologists working in different fields are published either in large works, the technical details of which are well calculated to frighten all but specialists, or in some one of the many scientific journals edited in all parts of the world. The number of these, however, is increasing yearly; and this fact considerably diminishes the chance of each to reach all those interested, again excepting the specialist, who of course makes it a point to see all that is written in reference to his own line of research.

Owing to this, much that is of vital consequence to the intellectual world at large is passed by or often remains long unnoticed by an important portion of the community.

It is therefore greatly to be desired that archæologists, who wish their labors to be of as much use as possible, should follow the example given them by Mr. W. M. Flinders-Petrie. This indefatigable scholar — with whom to drop the spade is but to take up the pen — has found the time, in the midst of his more serious scientific work, to publish a *résumé* of his recent explorations, under the title of "Ten Years' Digging in Egypt."

This little book will not only be useful to students, but must prove delightful reading to all who are interested in the progress of scientific discovery. Moreover, although condensed, as it necessarily must be in order to carry out the intention of the author, it is extremely suggestive, and opens to the mind possibilities most stimulating to every thoughtful student of the past.

In ten chapters the explorer lays before his readers the well-sifted residuum of new facts acquired to science through his excavations at Gizeh, Tanis, Naukratis, Daphnæ, Nebesheh, Hawara, Illahun, Kahun, Gurob, and Medûm, dwelling only upon such "finds" as distinctly bear upon the life, the history, the arts, and industries of man in the valley of the Nile, at the various periods represented by those sites.

It would be difficult to discriminate with regard to the relative value of these discoveries, each of which has elucidated some obscure point of science. Much light has been thrown upon the geology and the formation of the Nile valley as well as upon the climatic and topographical changes that have taken place since pre-historic times.

Valuable information has also been gained with regard to the tools and the devices employed by the Egyptians in the carrying-out of their artistic and architectural works, and upon the technical details of their earliest monuments.

The careful examination of the pyramid of Medûm — the tomb of King Seneferu (third dynasty), has established the evolution of the pyramid from the mastaba; and the discovery of its temple has placed before us, intact, the oldest-dated edifice in the world.

Moreover, the close observation of the well-executed hieroglyphs found upon the walls of the tombs of this ancient nekropolis has given many useful hints as to early Egyptian customs. For instance, the fact that the numerals turn out to be formed of lengths of rope, has suggested to Mr. Petrie the possibility of an original reckoning by means of ropes — a custom found in other parts of the world.

At this remote period stone and copper tools were used; only one bronze implement having been found in the course of the excavations. This exceptional piece Mr. Petrie regards as a trade importation; if, indeed, as is more likely, its presence is not to be accounted for by displacement from a higher level—it would be difficult to imagine whence true bronze could be imported in the fourth millennium B. C.

Under the reign of Senefern, the Libyan already appears as the civilized ally of Egypt; as is testified by the familiar hieroglyph of the Libyan soldier armed with his bow and arrow.

Traces of two distinct races — represented by distinct funeral customs — were also found among the graves near this pyramid. From these were obtained fifteen skeletons, five of which present cases of mutilation or deformity. The series is now at the College of Surgeons, where it will be studied and reported upon.

The other chapters of Mr. Petrie's book, in which he treats of his excavations in the Delta and in the Fayûm, are no less interesting. They furnish the reader with the principal data upon which the learned explorer bases his conclusions as to the relation of Egypt to the rest of the ancient world; and they naturally lead up to the eleventh chapter, in which these conclusions are expressed and vigorously set forth.

It was already fully established, by inscriptions found upon the Egyptian monuments, that the Mediterranean races were in contact with Egypt under the New Empire. Mr. Petrie has not only added to the evidence: he has recovered traces of foreign colonists residing in the Nile Valley, and has brought forward proof that close intercourse existed at least as early as the fifteenth century B.C., with a strong presumption in favor of the view that such intercourse must be carried back to a much earlier period.

From the facts which have come to light in Egypt and elsewhere, he argues that the civilization of the Bronze Age arose in Europe; that the use of bronze was introduced into Egypt by northern, not eastern, contact; and that it is from the mines of Hungary, Saxony, and Bohemia that the tool-makers of Pharaohnic times derived the tin which they used as alloy in their industry.

According to Mr. Petrie, Europe evolved its own culture as independently as Egypt itself, and in its relations with other civilizations it gave the East as much as it received. It is indeed to Europe that we must look for the origin of the bronze age; and there is little doubt that, if the place occupied by the primitive culture of Europe has so long been overlooked and ignored, it is principally because it did not evolve a graphic system, and therefore remains silent when the monuments left by the Oriental civilizations are bursting into words. Yet, "if silent, it is not dumb." The Mykenæ culture has left traces that lead us back at least to the sixteenth century B.C. (its decadence had already begun by 1100 B.C.). It was not confined to Greece; it was far-reaching, and represents the highest outcome of the bronze age. Its influence was felt from the Mediterranean to the Baltic, and it came into contact with Asia as well as with Africa.

"This bronze age," says Mr. Petrie, "is the source of the objects we now use. Thence these types were carried into Egypt a couple of centuries later by the Greeks. When we descend further, we see this independent culture of Europe prominent. The Saxons and the Northmen did not borrow their weapons, their laws, or their thoughts from Greece or Italy. The Celts swamped the south of Europe at their pleasure; and against the fullest development of Greek military science they were yet able to penetrate far south and plunder Delphi. They were powerful enough to raid Italy right across the Etrurian territory. When we look further east, we see the Dacians with weapons and ornaments and dresses which belong to their own civilization, and were not borrowed from Greece. In short, Greece and Italy did not civilize Europe, they only headed the civilization for a brief period."

Such are the conclusions reached by Mr. Petrie after ten years of patient investigation and of a most serious study of the Egyptian written and unwritten record. In matters of detail Mr. Petrie's interpretation of certain facts may be open to discussion; some time will probably elapse before the exact dates suggested by him for some of his "finds" are definitely adjusted to the entire satisfaction of experts in special branches of culture; but, in their bearing upon the history of civilization, his views may broadly be said to fit in with the general results of archæologists elsewhere.

Before the time of Dr. Schliemann's explorations, the Mykenæ culture had yielded so little, and its extent and influence were so ill understood, that the strong individuality displayed in its art was, if not unnoticed, at least unappreciated. With a better understanding of its remains, this art, wherever met with, reveals an originality of methods and of technic which cannot be denied, and its archaïsm has become evident.

It not only produced tombs, the grandeur of which outshone the dwellings of the living; and massive stone palaces, the walls of which were decorated with painted frescoes, — the work of a school whose artists borrowed neither their subjects nor their mode of treatment from others, — but metallurgy had reached a high degree of development; bronze, silver, and gold were wrought with the greatest skill; the engraver displayed a true artistic sense in the cutting of gems; and the manufacture of fine painted vases did credit to the originality of the Mediterranean potters. Altogether we are here in the presence of men who, in the course of their evolution, may have received suggestions from the outside world, but who never were servile imitators; and who, in their relations with other civilizations, "gave as much as they received."

Cyprus.—Dr. Max Ohnefalsch-Richter.

In Cyprus, the well-known explorer, Dr. Ohnefalsch-Richter, has detected — below other ancient human deposits found upon the island — the presence of a Phrygo-Thrakian civilization which belongs to the copper-bronze age.

This he regards as having certainly preceded all contact with Mesopotamia, Egypt, or Phœnicia; and as presenting many affinities with the kindred culture of which the late Dr. Schliemann found the traces in the lower strata reached in his excavations at Hissarlik — the site of ancient Troy. Dr. Richter's view is accepted by other authorities, notably by Dr. Dümmler, who goes even further, and regards both cultures as identical.

It is only later, under Sargon I. of Akkad, and Naram-Sin, his successor, that Mesopotamian influence can be detected upon the archæological record of Cyprus; and it is later still that direct contact with Egypt and with the Hittite Empire makes itself felt.

According to the facts brought to light by Dr. Richter, Greek influence antedates the oldest traces of Phœnician intercourse with the island; and the Greco-Cyprian syllabic character occurs in process of formation in the copper-bronze stratum, i.e., an earlier date than the first evidences of the use of the Phœnician character, which are contemporaneous with the introduction of iron. This seems to coincide with the downfall of the Hittite Empire, about 1800 B.C.

Dr. Richter concludes from these and other facts that the primitive civilization of Cyprus was evolved independently of the East, and that it must be regarded as running in parallel lines with those of Egypt and of Mesopotamia. This culture may be traced through Asia Minor, the Greek Archipelago, Greece, and Europe at least as far as Königsberg. Its oldest vestiges in Cyprus he dates as far back as the third or fourth millenium B.C. Beyond, there are evidences of a preceding stone age. Of these earliest remains Dr. Richter makes two divisions. The oldest stratum produces no statuary, no inscriptions; but it contains hand-made pottery, and copper or weak bronze tools of small dimensions, in the smelting of which a weak alloy of zinc was used. In the second, or later, stratum of this archaic period, lance-heads appear, and with these are found vases of the Mykenæ type.

According to the facts which he has collected, the Greek influence felt here is that of the Peloponnesian tribes, the Arcadians,

Achæans, and the Laconians, whom he recognizes among the nations mentioned in the Egyptian texts (Akuaivasa, Sakalusa, etc.). It is to these, it would seem, that was due the invention of the sword, which first appears in Cyprus in the form of a much enlarged Cyprian dagger, and is found associated with Mykenæ pottery. It is also at this time that defensive metal armor occurs. Many of the statues of gods, priests, and others exhumed by Dr. Richter are represented wearing the round helmet with a ball-crest, which is depicted upon the Egyptian monuments as especially belonging to the Mediterranean peoples; and their general aspect also agrees with that attributed to these races by the Egyptian artists.

It will be remembered that these round helmets are mentioned, along with coats of mail, in Homer; and that, in the great epic, Agamemnon is represented as having obtained his equipment from Cyprus. The Cyprians continued famous as metallurgists, and, even after iron was introduced, their swords remained celebrated — at least we may judge so from the fact that Alexander the Great is stated to have carried a Cyprian sword.

Dr. Richter is now engaged upon the publication of a large illustrated work which will give a full account of his discoveries, with his interpretation of the facts that he has had the good fortune to bring to light in the twelve years of his Cyprian explorations. It is sincerely to be desired that he may be induced to follow Mr. Petrie's example; and that, along with the exhaustive volume more particularly intended for specialists, he will also publish a *résumé* embodying his principal results.

CLIFF- AND CAVE-DWELLERS OF CENTRAL ARIZONA.

BY J. W. TOURNEY, TUCSON, ARIZONA.

THERE is no part of the United States that is of more interest to the archæologist than our great south-west. This region, which includes all of Arizona, has but little rain, and during the long summer lies scorching under an almost tropical sun. It is true that in the mountains of the Territory the heat is greatly lessened, but from our geographical position we are subject to prolonged droughts for weeks and months at a time.

It is a question whether our present meteorological conditions are the same as when the cave- and cliff-dwellers cultivated fields upon our now barren mesas. Throughout this vast territory are hundreds of ruined casas and vacant caves, whose silent walls and rough-hewn stones are the only history we have of this early people. Whither they have gone and who they were is shrouded in the grave; neither the fierce Apache nor the more gentle tribes of the south know who were the architects of these interesting and wonderful structures. The Zuni and Moqui have been questioned, but without result. They all shake their heads. Even the oldest of the Indians, with traditions extending back many generations, know nothing of the builders of these old stone and adobe walls which have withstood the elements for so many years. At some future time these silent walls may speak out through the mind of man and give to the world glimpses into the history of a people who are now lost in antiquity. Peculiar marks on rocks and pottery all mean something, and the world is waiting for someone to unlock these closets and let a ray of light upon their mysterious symbols.

In the valley of the Verde River, not far from the now abandoned fort, and on the surrounding cliffs and hills are many old ruins. Many of these are as interesting and as little-known as any to be found in the south-west. Far from railroad and in a wild and rugged region, it is not strange that they have been studied so little. The banks of the river and many of its tributaries are lined with ruins. The prominent cliffs are crowned with walls of great flat stones, many of them as erected ages ago.

The clear water of Beaver Creek reaches the Verde a few rods above the old fort. A ride of several miles along this creek brings one to high cliffs extending a hundred or more feet above the waters of the creek. In the perpendicular walls of one of these cliffs is a well-preserved ruin known as Montezuma's castle. It is midway between the rim of the cliff and the bed of the stream, and is neither house nor cave, but a combination of the two. Not accessible from the summit of the cliff, it can only be reached from below, and even here not without the use of a ladder, which, if short, must be pulled up from one ledge to another in making the ascent. The entire front is of artificial walls built of large, flat pieces of limestone, with openings here and there for doors and windows. The rooms are small, only about five feet to ceiling. Generally a small opening two or three feet in diameter joins one room with another, and a similar orifice in the ceiling

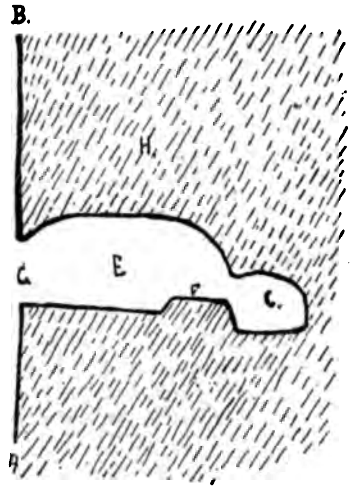


Diagram showing vertical section of cave at right-angles to cliff. The line *AB* represents face of cliff; *C*, a small cave at rear; *E*, main cave; *F*, rock bench; *G*, entrance; *H*, rock of cliff.

gives access to the room above. The ceilings are so low that steps are not necessary to pass from the first floor consecutively through the several stories of the structure. The openings in the ceilings never fall directly under each other. If the orifice is in the north-west corner in the first ceiling, it will be in the south-east corner in the next ceiling above, and so alternating back and forth to the top. This of course eliminates the possibility of falling more than five or six feet, or the height of one story. The

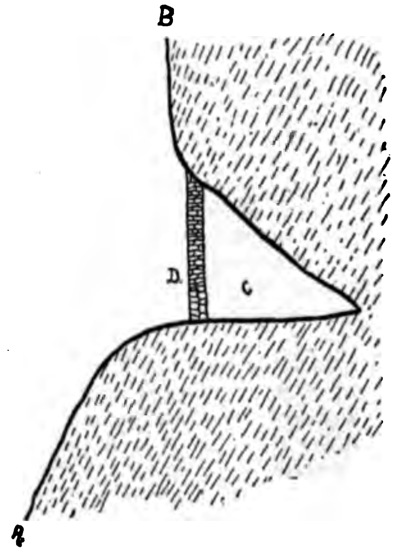


Diagram showing vertical section through large horizontal fissure; *AB*, line representing face of cliff; *C*, enclosed room; *D*, wall of masonry.
Type of pre-historic dwelling along the Grand Cañon of the Colorado River.

floors are mostly of flat stones supported on timber cut from the surrounding mountains.

Many of the timbers are perfectly sound, while others, where the rains have beaten against them, have decayed away and the floors fallen in. A few of the rooms facing the creek have cross-walls built of limestone, without mortar or cement of any kind. They all show considerable skill in their construction. The rooms at the rear are dark, dungeon-like caves hollowed from the solid

rock, and are now the abode of thousands of bats, which fly about in great numbers when disturbed by the sight-seeker.

A few miles above Montezuma's castle, on the opposite bank of the creek, a conspicuous cone-like mountain rises a few hundred feet above the surrounding country. On making the ascent, the summit was found to be a narrow rim enclosing a crater some three hundred feet in diameter and with nearly perpendicular walls. Standing on the rim, one can look down a hundred feet upon the dark-blue water of a small lake in the bosom of the mountain. The lake, a hundred yards in diameter and of unknown depth, is known as Montezuma's well. In the steep sides of the crater are a number of caves, which at one time were the abode of man. A few are natural, but the greater number are the result of human effort.

The rim is crowned with the fallen walls of an ancient ruin more than a hundred feet long. Far down the mountain-side, below the level of the water in the crater, the outlet of the well flows from between an opening in the rocks. This stream is large and constant, and at present is used to irrigate a ranch in the valley below. Ages ago the builders of caves and castles utilized this same stream to irrigate portions of the neighboring rich valley.

A short distance down the valley a stone and cement ditch of pre-historic make can be easily traced for many rods. Ranchmen in building ditches frequently follow the courses of ancient ones. In July, last year, in constructing an irrigating ditch near old

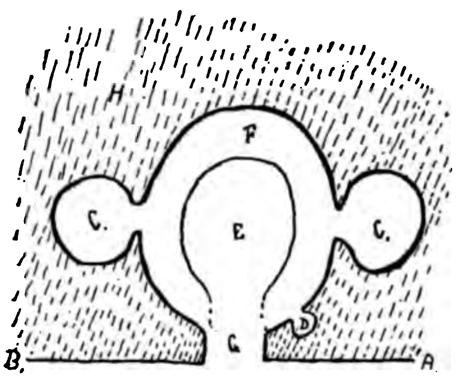


Diagram showing floor-plan of cave. The line *AB* represents face of cliff; *C*, lateral caves; *E*, main cave; *F*, rock bench surrounding main cave; *G*, entrance; *D*, small cavity hollowed in rock near entrance; *H*, rock of cliff.

Fort Verde, on the west side of the river, the workmen found evidences of an ancient ditch buried some twelve feet below the surface. Many of the old ditches have been found upon mesas where under present conditions it would be impossible to get water to fill them. Frequently they lead from what are now dry washes which only carry water a few days at a time and then only after heavy rains. This seems to indicate that there was a time when the now dry washes carried water much more constantly than at present.

More numerous than the casa and cliff ruins are the many caves excavated from the sand and limestone cliffs along the east bank of Verde River for some miles below the old fort. At a distance the openings into the caves look like black spots on the white cliffs. They are arranged in long rows, tier above tier, and are nearly alike in structure. All are more or less inaccessible from the valley below. The entrance is an irregular arched opening about four feet high and from half to two-thirds as wide. The cave proper is about twelve feet in diameter and from four to six feet to ceiling. The room is more or less circular in outline. A rock bench from twelve to eighteen inches high occupies the cave on all sides except at the entrance. This bench is about three feet wide, and gently slopes toward the centre of the room. Charred embers, meates, grinders, broken pottery, and fragments of reed mats were scattered about or were under the heaps of *débris* which covered the floor. Opening into the main cave at either side and also frequently at the rear were smaller ones, which were three to five feet in diameter and about the same to ceiling. In nearly all the caves visited the floors of the smaller ones were from one and one-half to two and one-half feet below the floor of the main room.

It is probable that the small caves were used for the storage of grains and other material. No light finds its way into the small lateral and rear caves but the little that comes in through the small openings leading to the central room. In two or three instances I found two large caves joined by a small passage-way uniting the lateral caves. Occasionally, hollowed from the wall, at one or both sides of the main entrance, some two feet above the floor, were small pocket-like cavities about twelve inches in diameter and nearly spherical in outline. The openings to them were four or five inches across, so large that one could easily reach with the hand any object that might be placed therein. Not only the floors of the caves, but in many instances the entire face of the cliffs, were covered with broken pottery, some of it of much better quality than that made by the Indians of Arizona to-day.

So far as I have had opportunity of examining, the caves of this region are much different from those in the cliffs along the Colorado River and elsewhere in the territory. Here it is evident they have been hollowed out by human effort. In other localities natural caves and large horizontal fissures in the cliffs were the homes of this early people.

PALÆOLITHIC MAN IN NORTH AMERICA.

BY DR. C. C. ABBOTT.

THE ghost of palæolithic man has arisen to plague the geologists at Washington; and those that look upon them as little gods are all shouting "Me, too." As the cause of all this mischief, it is fitting that I should speak in my own defence. The scientific men of Washington claim a monopoly of knowledge and so occupy a peculiar position, self-assumed, of course. That which is offered the world independently of them, must be stamped by their approval or condemned, and it is never the former. This condition of affairs really handicaps them at the outset, and not one can enter the field unbiassed. Indeed, they go out instructed to bring in such and such results, and none other. This is pre-eminently so in the question of the antiquity of man in North America. The recent appearance of Wright's book, "Man and the Glacial Period," has set their pens and tongues wagging, but palæolithic man is not to be downed even by such an array of notables marshalled to defeat him. Salisbury's cunning argumentation, McGee's shaggy front, Holmes's imperious "begone!" and Brinton's persuasive smile do not make him afraid. He returned to earth in his own good time and came to stay!

Of the alleged evidences brought forward by others I have nothing to say, but something to record concerning my own investigations, that may have a bearing on the question. We must admit that, at some given day in the past, man appeared on this continent; but just when, no one has ventured to assert. Certainly in no one communication to scientific or popular literature have I done more than claim the discovery of evidence of his comparatively primitive condition when he did arrive; and now after twenty years of careful, unremitted study of the valley of the Delaware River, I see no reason to change my opinion, but a great deal to substantiate it.

Were the evidences of man's occupancy of this region one associated and confused mass, an attempt made to dissociate its components into rude and more elaborate forms and to say of the former, *this is old*, and of the latter, *not so ancient*, then the scientific world might well be up in arms and cry down the apparent absurdity — but this is not the case.

Of course, if we claim, as, for instance, Mr. Holmes practically does, in spite of denial, that every so-called palæolithic implement is a "reject," whether the man who threw it aside lived in Europe or America, the whole subject falls to the ground; but accepting palæolithic man as a one-time feature of other continents, and believing no geological reasons have been brought forward why he might not have lived in North America also, it is justifiable to consider the archæological significance of such objects as the late Wyman said were not distinguishable from European forms, except by the material of which they were made.

Now, as a matter of fact, a considerable number of just such forms have been found in the gravel deposits at Trenton, N.J., and at a significant depth; but, says the geologist, what of the age of this deposit? The whole question hinges on this. Professor Salisbury asserts that since the deposit was originally laid down, it has been reassorted. Grant this, and what then? If the reassortment took place in "Indian" times, how does it happen that only this one form and simple flakes are found entombed? Holmes here steps in and says "easy enough," the Indian went to the river-shore, chipped pebbles, and retired to the back country, leaving his "rejects." But are we to suppose the Indian never went to the water's edge for any other purpose? Did he not take his finished implements to the river to fish and hunt? Did he not cross the river by a raft, canoe, or by swimming? Did he necessarily always live back from the stream? Common sense points out that he must have had the whole range of his goods and chattels continually at and on the water, and are we to suppose that never a knife, arrow-point, bead, or pot was lost? It is too absurd to consider; and this reassortment of the gravel-beds must have buried a great deal more than "rejects." Again, it has been asserted that the assumed palæolithic implements are only in "talus." Carvill Lewis, according to Brinton, says what I held to be undisturbed layers, were really an "ancient talus." Possibly, but how ancient? In at least a dozen instances this asserted "old talus" was caused by floods having a transporting power equal to piling up layers alternately of sand and gravel, and then, as if to anticipate the present tempest in a tea-pot, placed a bowlder, weighing tons, over it all, for fear that the poor palæolith might run away. Now, when grooved axes and polished celts are found under like conditions, I am willing to leave the field as fast as my short legs will permit, and not before.

Professor Salisbury has asserted that there is need of expert testimony to determine the precise age of the implement-bearing gravels, and Dr. Brinton insists that no opinion as to the geological age of a gravel can be received from any but an expert geologist. Grant it; but the trouble is these "expert geologists" are *raræ aves* that were never yet known to agree among themselves, and it becomes a mere matter of personal opinion after all. I lay claim to a smattering of gravel-ology. I have lived on pebbles so long that I have become flinty-hearted so far as criticism is concerned, and when I find gravel stratified and unstratified, I know and assert the difference; and when a palæolithic implement is found in gravel beneath layers of sand and pebbles, beneath huge bowlders (not merely at a lower horizon, but directly beneath them), I do not, and no reasonable person should want another to tell him that the two were laid down together, or the big bowlder was dropped upon the implement, which anticipated its coming. Up pops some "authority" and declaims the possibility that the ground was washed from beneath the big stone and the implement slipped in. Well, we can go on supposing till the crack o'doom, but as to proof, that is another matter. These geological jugglers will prove yet that the Indians bought the Delaware Valley from William Penn.

Certainly too much value is put on this matter of expert testimony. Then, again, in spite of all that has been written and said, the assertion is made that palæolithic implements are found only at the present river-shore. Of course we find them there now, because the gravel is exposed, but not there alone. A full mile back from the river they have been found in digging cellars, sinking wells, and in the cut of the Pennsylvania Railroad, east of Trenton, N.J. All this area may have been "reassorted," but in such delicate fashion that the strata are not broken, and it suggests that the manner of it was like turning over a book from one cover to the other.

Again, it has been objected that no animal remains have been found; but Cook found a mastodon, and I have, more significant yet, a valve of a Unio; and what of human remains, long since reported? There are, too, at the Peabody Museum, three human crania, two of which were taken from the gravel and one found in the bed of a creek, and these three, identical in character, stand alone in a collection of nearly three thousand Indian crania.

It is the weak point of Wright's book that he did not prepare the archæological portion at the Peabody Museum, with my collection under his eyes. It he had, the critics would not have had a leg to stand upon.

The implements, too, speak for themselves. If "rejects" as Holmes dogmatically asserts, why is it that they were carried to the high ground, and are found to-day, solitary and alone, silent witnesses of that long ago, when it was the principal weapon of the early man who used them? And if "rejects," made at the water's edge, where are the chips resulting from their fashioning? They are not scattered broadside over the river-shore as are the implements; but we do find in spots where "rejects" were made in numbers, and know the fact because of the accumulated chips. It is easy to conceive a theory and bend the facts to it; very, very easy; but the trick is found out, sooner or later.

"But they show no sign of use" pipes some impatient kicker. Prove it; and does the spear or arrow-point show signs of use? Of over a thousand chipped jasper scrapers in the Abbott collection at the Peabody Museum, not a half-dozen show sign of use, and the same may be said of drills.

These rude implements are made of argillite, and the use of this material was continued down to the time of European contact, being less and less used after the discovery of jasper. The magnificent results of Mr. Ernst Volk's explorations, under the direction of Putnam, in the valley of the Delaware, clearly prove this, and so substantiate what I have claimed for all these years; and is it not significant that some of the most finished specimens of palæolithic implements have been found *in situ?* By what authority do the critics say they are too rude to be effective? Is any person living so in touch with primitive man to-day as to assert what he could and could not have used? It is well to bear in mind that many an undoubted Indian implement, just as rude, was used by these later people. Look at the rude spades and slightly chipped but girdled pebbles that were used as club-heads.

Of course in the days of palæolithic implement-making there would be "rejects," and the critic must not attempt to prove too much, because such are found, even in undisturbed gravel. Many a pebble, too, has been chipped until suggestive of an implement, by the detaching of flakes to be used as knives, as Mercer pointed out at the Rochester meeting of the A. A. A. S., and a splinter of stone was not too elaborate an implement for supposed palæolithic man to have used.

And now, in conclusion, let us remember that the native American — the Indian — is a type distinct from all other peoples; let us not forget that their languages are all a purely home product, and that these facts show undeniably a necessarily long occupancy of this continent, shut out for centuries from all the world. If he, *as a fully equipped Indian*, came from another region beyond the seas, his similarity to the people of that region could be traced. As it is, he came, so far as our knowledge now extends, when man over the whole world was not racially developed as now, and so, when in a comparatively primitive condition; such a condition as is suggested by the simplest of implements, whether for the chase or domestic uses. Here, in North America, this early man became a potter, invented the bow, and gradually reached that status of culture, differing in degree in different parts of the country, in which he was found by European explorers.

As a student of archæology, I submit that this occupancy of the continent commenced when there was a changing condition of the river valleys in progress; but whether that change was subsequent to the glacial epoch or during it, deponent saith not. That it was during a time when rock-transporting floods were common, I do claim. That it was when ruder than ordinary Indian implements were the common tools of the people, I do claim, for how else could only such rude forms be associated as they have been shown to be with gravels that show no evidence of disturbance except such as forces not now in operation, effected? It is true, palæolithic and Indian objects are now associated, but they are also separate and apart. What I contend for is the sequence of events of the original use of a rude weapon or tool, the one implement of that day that was manufactured, and, as time rolled on, the production of more elaborate forms, and all that pertains, the world over, to the accepted neolithic stage of human advancement.

rule are much the same as those enumerated in the above paragraphs. Of the three pronunciations of this termination *-īde*, *ĭde*, and *ĭde*, in varying degrees of usage amongst us, the second appeared undoubtedly to be the most preferable; *-īde* is an uncommon, almost unnatural, pronunciation of the vowel in English, although it would bring our usage into unison with that of European countries, and simplify phonetic values for the ears of foreigners; *-īde* leads frequently to confusion with *-īte*, and is the value of *i* farthest removed from European usage; *-ĭd* approximates closely to the Continental *i*, into which it is easily lengthened, is readily recognized by the foreign ear, is not confused with the termination *-īte*, is in line with present phonetic progress, and has the backing of authority and usage. The short sound of *i* naturally dictates the dropping of the final *e*. "According to Smart and Cull, chemical terms ending in *-ide* — as bromide, chloride, etc. — should be pronounced with the *i* long; but all other orthoëpists are unanimous in making the vowel short; and the propriety of the latter mode of pronunciation is established by the fact that this whole class of words is not unfrequently spelt without the final *e*, thus *bromid*, *chlorid*" (Webster's Dictionary, "Principles of Pronunciation," p. xliv.).

In conclusion, it may be said that the chemical section of the American Association recognizes the fact that there is still room for advancement in the path of phonetic reform, and that questions may still arise with regard to divergent usage or defects in existing rules. The task of collecting and collating such questions and of presenting them at a later date to the Association for action has been assigned to Professor Jas. Lewis Howe of Louisville, who will gladly receive all information, suggestions, or propositions pertinent to the subject from those interested in the perfecting of our chemical nomenclature.

BOSTON SCHOOL-BOYS.

BY FRANCIS GALTON, F.R.S., LONDON, ENGLAND.

NUMEROUS results may be shown to flow from the excellently arranged data in the valuable memoir of Professor H. P. Bowditch on the Growth of Children (Twenty-Second Annual Report of the State Board of Massachusetts, Boston, 1891). Permit me to draw attention to two of them.

It is necessary to premise that the method was adopted by him of describing classes by means of eleven percentiles, but, for the present purpose, three are enough, namely, the 10th, 50th, and 90th. In other words, it is sufficient now to deal with the statures of the persons who occupy those posts in any class along whose length 100 posts have been marked at equal intervals. It follows that 10 per cent of the whole class are shorter than the 10th percentile and 90 per cent are taller. These conditions are reversed in respect to the 90th percentile; as for the 50th, it is the median value, which one half of the class falls short of and the other half exceeds. The median in most series differs little from the arithmetical mean, and may be used instead of it, as a serviceable standard of comparison.

The variability of a series may be measured by the difference between any two named percentiles. The wider these are apart the more is the scale magnified; on the other hand, the less trustworthy does the measure become. In the present series we can with propriety use the difference between the 10th and the 90th percentiles, but we cannot in all cases, owing to the paucity of data, use that between the 5th and the 95th; the former will therefore be here adopted as the measure of variability.

In order to compare on equal terms the variability in stature of growing boys at different ages we must so reduce their measures that the median shall in all cases be the same. It is customary for this purpose to take the median as 100, but there is more significance in the results when it is taken at a value that represents the average stature, or thereabouts, of male adults. Here it will be taken at 67 inches. In the following table the 10th and 90th percentiles for the several ages are those given by Bowditch, after multiplying them by 67, and then dividing the result by the median stature at that age.

Calculated from Tables by Bowditch of Heights of Boston School-boys.

Age last Birthday.	Of American Parentage.					Of Irish Parentage.				
	Number of Cases.	Median.	Percentiles × (67 ÷ Median).		Differences.	Number of Cases.	Median.	Percentiles × (67 ÷ Median).		Differences.
			10°	90°				10°	90°	
5	201	41.84	62.9	71.0	8.1	366	41.70	63.3	71.2	7.9
6	342	44.00	63 5	71.1	7.6	503	43.90	63.3	70.7	7.4
7	369	46.36	63.5	70.9	7.4	562	45.68	63.5	70.9	7.4
8	407	48.34	63.2	70.9	7.7	588	47.80	63.6	70.6	7.0
9	381	50.07	63.5	71.2	7.7	556	49.61	63.7	70.9	7.2
10	360	52.24	62.7	70.5	7.8	571	51.62	63.6	71.1	7.5
11	350	54 14	62.5	70.5	8.0	548	53.17	63.4	70.6	7.2
12	373	55.68	63.4	72.2	8.8	497	54.89	63.2	70.9	7.7
13	391	58.14	62.3	71.8	9.5	463	56.58	63.7	71.9	8.2
14	386	60.77	62 6	72.8	10.2	334	58.81	63.3	71.5	8.2
15	342	63.17	62.3	71.4	9.1	155	60.98	63.0	71.9	8.9
16	232	66.03	62.5	69.9	7.4	61	64.42	(61.8)	(70.4)	(8.6)
17	128	69.39	63.2	71.0	7.8	26	Too few.			(?)

On examining the columns of differences, we find a remarkable increase in the differences between the 10th and 90th percentiles during the interval between the ages of 11½ and 15½ years; that is, of boys who at their last birthday were 11 or 15 years old. The period in question is that during some portion of which the growth is apt to be temporarily accelerated, but the precise epoch of acceleration differs; some boys being more precocious than others. Consequently the variability among boys of the same age, between the ages of 11½ and 16½ years, is greater than at other times. The point to which I wish now to direct attention, is the much greater variability during this period of the children of Americans than of those of Irish, for which it seems difficult to account. It can hardly be owing to variations of nurture, because its influences would probably be greatest on those classes who were least assured in their habits of life; now it is difficult to suppose that the Irish in Boston are, as a class, better established and more well-off than the Americans. As regards the effects of race, it is true that the Americans are more mixed in origin than the Irish, but we should have expected purity of race to manifest itself by a reduced variability at all ages, and not only at the particular period we are considering. However, it seems to be otherwise, and that the great variability of American children at the time in question may really be due to their mixed ancestry. In confirmation of this variability being a racial effect, we note how much earlier the epoch of its increase sets in among the children of Americans than among those of Irish, the difference amounting to at least one year. Anyhow, these statistics suggest the possible existence of an hitherto unobserved physiological difference between the children of the Americans and of the Irish, which might repay investigation.

A considerable agreement will be found in the figures contained in each of the four columns of percentiles in the table; their variations ranging through 1.2, 1.9, 0.7, and 1.8 inches, respectively. In other words, they range between limits that are hardly more than one inch on the average apart, while of course the range in other percentiles that are nearest the median is progressively smaller, till at the median itself the range is *nil*. There is, therefore, a fair approximation towards constancy in the ratio between any given percentile and the corresponding median that holds good for all these ages. It follows that if we are given all the eleven percentiles of stature that are found in Bowditch's memoir, together with the median heights for the several successive ages, we should have sufficient data to reproduce, in a roughly approximate way, the entire table of distribution of growth. The variability and the median are not such independent

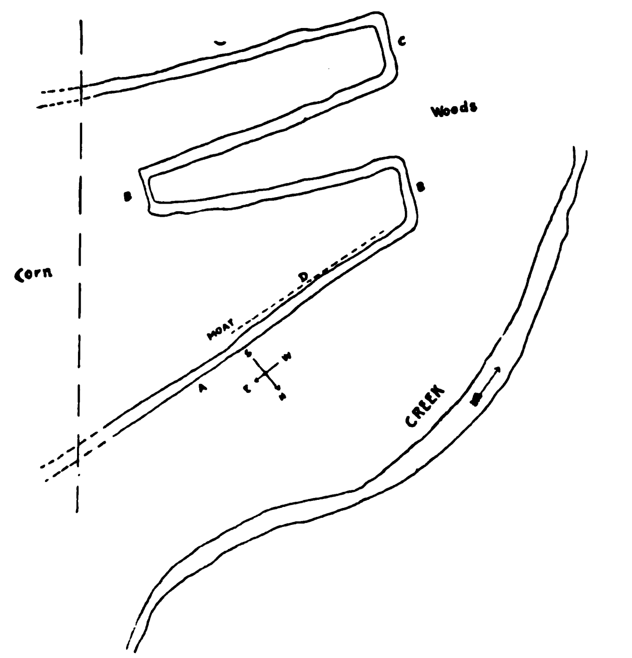
values as they are commonly considered to be. As, for example, the amount of the changes in the length of a chain under the influences of changing temperatures is related to the length of the chain, so we should expect the variability in the growth of large organisms to be on a larger scale than in small ones. There are more cells affected simultaneously by the same environing conditions. The rationale of a connection between the variability and the median may in some cases admit of being clearly made out, and in all cases it deserves more thought than it has hitherto received.

AN ARCHÆOLOGICAL DELUSION.

BY THOMAS GORDON KING.

THE daily papers have lately published accounts of a new "serpent" effigy. It existed in southern Ohio, in Warren County, and, according to two doctors of the neighborhood, measured some nineteen hundred feet in length. It was said to surpass the famous Adams County serpent.

Professor Putnam's assistant, Mr. H. I. Smith, spent some time surveying the structure, this summer. He trenched the embank-



ment in several places and searched the neighboring fields for traces of a village site. The accompanying rough outline gives an idea of the "serpent" so far as it can be traced. In the cornfield it will be seen that the embankment cannot be distinguished; in the woods it is plain. The part in the woods, which at present is some two feet in height, does not appear to be serpentine in character. It is almost unnecessary to add that if the remaining part of the structure does not represent a serpent, the obliterated portion never did. There is not the slightest grounds for the assumption that this figure in any way resembles the Adams County effigy. The latter is laid out in graceful curves, which *suggest* the character of the effigy. The embankments of the Warren County structure resemble those of Fort Ancient. The long straight line *A*, and the sharp, squared bends *B* and *C* are the exact counterpart (although much smaller) of certain parts of south Fort Ancient.

A live snake could not take the form of this "new serpent" without breaking his back in three places. (I write under the impression that aborigines imitate living and not dead animals). There is a slight moat at the base of the embankment, which, although nearly filled, can still be traced. To one who has seen all the shell, bone, stone, and clay representatives of serpents and serpent-symbols displayed in the museums of this country, the "new serpent" does not appear serpentine. I cannot see how the angular corners *B* and *C* and the moat *D*, and the embankment *A*, mark other than parts of a peculiar defensive earthwork.

The primitive Americans in drawing, moulding, building, or sculpturing snakes evinced a certain similarity of idea in design, and employed a common mode of execution. Yet this "new serpent" has nothing in common with other serpents! (Read Holmes on "Art in Shell.") As this new serpent is such a poor representative that Professor Putnam and other competent judges dare not place themselves on record in naming it, I have no hesitancy in calling it a rude fortification. The native Americans were sufficiently competent to execute a figure with such distinctness and closeness of resemblance as would allow of no dispute. Those who are interested in following the discussion further will please compare the diagram submitted with Squier and Davis's plan of the Adams County effigy. There are many similar combination works in the Ohio Valley, and it is probable that the thorough exploration of several might furnish evidence as to the purpose for which they were erected.

LETTERS TO THE EDITOR.

Man and the Glacial Period.

I ACKNOWLEDGE with pleasure the courtesy with which Dr. Brinton, in his review of "Man and the Glacial Period," has dealt with the question of the genuineness of the reported discoveries of implements in the glacial gravels of the United States. This, of course, was the first question to be settled, Were implements of human manufacture really found in undisturbed strata of gravel which was deposited during the glacial period? If this question is settled in the affirmative, then all glacial geology has direct bearing upon the question of archæology. If it is decided in the negative, glacial geology remains the same, but it ceases to have interest in connection with archæology. I am glad to have the issue so clearly made by Dr. Brinton, and thereby to have occasion to present more specifically my reasons for belief in the genuineness of these discoveries.

The evidence naturally begins with that at Trenton, N. J., where Dr. C. C. Abbott has been so long at work. Dr. Abbott, it is true, is not a professional geologist, but his familiarity with the gravel at Trenton where he resides, the exceptional opportunities afforded to him for investigation, and the frequent visits of geologists have made him an expert whose opinion is of the highest value upon the question of the undisturbed character of the gravel deposit. The gravel banks which he has examined so long and so carefully have been exposed in two ways: 1st, by the undermining of floods on the river-side, but principally by the excavations which have been made by the railroad and by private parties in search of gravel. For years the railroads have been at work digging away the side of the banks until they had removed a great many acres of the gravel to a depth of twenty or twenty-five feet. Anyone can see that in such conditions there has been no chance for "creep" or landslides to have disturbed the stratification; for the whole area was full of gravel, and there was no chance of disturbance by natural causes. Now Dr. Abbott's testimony is that up to the year 1888 sixty of the four hundred palæolithic implements which he had found at Trenton had been found at recorded depths in the gravel. Coming down to specifications, he describes in his reports the discovery of one (see "Primitive Industry," 492) found while watching the progress of an extensive excavation in Centre Street, which was nearly seven feet below the surface, surrounded by a mass of large cobble stones and boulders, one of the latter overlying it. Another was found at the bluff at Trenton, in a narrow gorge where the material forming the sides of the chasm had not been displaced, under a large boulder nine feet below the surface (ib. 496). Another was found in a perpendicular exposure of the bluff immediately after the detachment of a large mass of material, and in a surface that had but the day before been exposed, and had not yet begun to crumble. The specimen was twenty-one feet from the surface of the ground.

In all these and numerous other cases Dr. Abbott's attention was specially directed to the question of the undisturbed char-

acter of the gravel, having been cautioned upon this point in the early part of his investigations.

Nor is he the only one who has found implements which were clearly in those undisturbed gravel deposits. Professor Shaler (Report of the Peabody Museum at Cambridge, Vol. II., p. 45) found two of the implements twelve feet below the top of the bank, where he says that it was difficult for him to believe that they could have travelled down from the superficial soil, and he expresses it as his opinion, after having gone over the ground with Dr. Abbott, that the implements which Dr. Abbott had found occurred under conditions that make it "quite unquestionable that they were deposited at a depth of many feet below the soil, and are really mingled with the drift matter that forms the section before described." This is the description which I have quoted in my volume (p. 242). Professor Putnam, also, personally found implements in position which he decided to be certainly undisturbed gravel (see 14th Annual Report of Peabody Museum, p. 23, and Proc. Boston Society of Natural History for Jan. 19, 1880).

The question of the occurrence of these implements in undisturbed gravel was so thoroughly discussed by the scientific men in Boston who visited the region about 1880 that I had supposed there was no longer any reasonable doubt concerning the facts, and I feel sure that anyone who goes through the records of the Peabody Museum and the Boston Society of Natural History about that time will be convinced. At the same time I would say that I have been unable myself to find any implements in place, though I have frequently examined the bank. But I have not felt at liberty on that account to doubt the abundant testimony of others who have. If we are limited to believing only what we ourselves have seen, our knowledge will be unduly circumscribed; and though I might be more certain of the facts if I had seen them myself, I do not see how I could increase the confidence, in the facts, of other people who could disregard the testimony already in hand.

Passing now from the discoveries at Trenton, N. J., to those in gravels of corresponding age in Ohio, we do not come to the subject with the same amount of incredulity with which we first encountered the evidence at Trenton. Dr. Metz has been for years co-operating with Professor Putnam in various investigations, and the discovery of a flint implement by him in excavating for a cistern in his own yard was such that no reasonable question can be raised as to its having been undisturbed since the deposit was made, and there can be no reasonable question that the deposit was made during the continuance of glacial conditions in the State. I have described the conditions in a report to the Archæological Society of Ohio for December, 1887.

The discovery of a palæolithic implement at New Comerstown, Ohio, by Mr. W. C. Mills, is an equally well-attested case. Mr. Mills, like Dr. Abbott, resided in close proximity to an extensive glacial terrace to which the railroad was resorting for ballast. Many acres of the gravel have been removed. During the progress of these excavations Mr. Mills repeatedly visited the pit, and after a fresh excavation discovered this implement in a perpendicular face of the bank fifteen feet below the surface. The facts were recorded in his diary and the implement placed in the general collection of Indian relics which he was making. Mr. Mills was at that time engaged in business in the place, but he had been a pupil of Professor Orton in geology, and was well qualified to judge of the undisturbed character of the gravel in which this implement was found. As anyone can see by consulting the photographic illustrations on pp. 252 and 253 of my volume, the implement itself is an exact duplicate, so far as form is concerned, of one which I have in my own collection, from Amiens, France, and which came to me, through Professor Asa Gray, directly from the collection of Dr. Evans in London. The New Comerstown implement was submitted to Professor Haynes of Boston and to others at a meeting of the Boston Society of Natural History, and by them pronounced to have all the essential characteristics of palæolithic age. The full report upon this is found in Tract No. 75 of the Western Reserve Historical Society, Cleveland.

As to Miss Babbitt's discoveries at Little Falls, Minn., I have nothing further to say than that up to the present year no serious question had been raised concerning the glacial age of the gravel in which her implements were found. But as questions have now been raised in view of recent examinations, I will not attempt to discuss the matter until the facts are more fully published. But the removal of this case from the category would not disturb confidence in the evidence connecting man with the glacial period in New Jersey and Ohio.

The statement of Dr. Brinton that a well-known government geologist had recognized the Nampa image "as a clay toy manufactured by the neighboring Pocatello Indians" is news to me, and it is due to the public that this official's knowledge of the subject should be more specifically detailed. The facts as I have brought them out by prolonged and minute inquiry do not warrant any such flippant treatment of the evidence. Professor Putnam, to whose inspection the image was subjected when it first came into my hands, at once pronounced it an antiquity of some sort, unlike anything which he knew to be in existence among the aboriginal tribes. I need not say that Professor Putnam's opinion upon a question of that sort is of the very highest value. There were upon the image patches of the anhydrous oxide of iron, which to him and other experts were indubitable evidence that it had lain for a long time in the earth. Subsequently I ascertained, while on the ground at Nampa, that the shade of color in this iron oxide upon it corresponded exactly to that which had formed upon the clay concretions which came up in large quantities from the same stratum in which the image was alleged to have been found. I have also, I think, made it evident that the burying of human relics even to the great depth of 320 feet in the Snake River Valley may not be much more surprising than the burial of the remains of man in Pompeii and Herculaneum, and that the date of this burial may not have been very many thousand years ago. The direct evidence to the fact that this little image, an inch and a half long, came up from the depth reported is about as convincing as we can have for any fact which depends for credence upon human testimony. There has been nothing with regard to the appearance of the parties suggesting fraud. Mr. Cumming, the superintendent of that division of the Union Pacific Railroad, whose attention to the facts was called the day after the discovery, is a Harvard College graduate, of extended legal education and wide practical experience, who knew all the parties and was familiar with the circumstances, and investigated them upon the ground. Charles Francis Adams emphatically affirms that Mr. Cumming's evidence in this matter is entitled to as much consideration as the evidence of any scientific man would be. Anyone who wishes to get my detailed report of the evidence will find it in the Proceedings of the Boston Society of Natural History for Jan. 1, 1890, and Feb. 18, 1891.

The discoveries of human implements under Table Mountain in California are in close analogy with this discovery at Nampa, in the Snake River Valley, and the same remarks have been made respecting them that Dr. Brinton reports concerning the Nampa image, namely, that they are modern implements at present in use among the local tribes of Indians. But no such offhand opinion as this can break the force of the evidence which has accumulated in support of their having been found in deposits which have been undisturbed since the great lava outflows which constitute what is called the Sonora Table Mountain. The evidence concerning the Calaveras skull has been exhaustively discussed by Professor Whitney of Harvard College, who pronounces the facts to be beyond all reasonable doubt. At the meeting of the Geological Society in Washington in January, 1891, three independent discoveries of human implements in conditions similar to those assigned to the Calaveras skull were presented. I had myself obtained information at Sonora of the discovery of a stone-mortar in the tunnel of the Empire mine of which the evidence was satisfactory beyond reasonable doubt. The discovery was made by the assistant surveyor of the county in the tunnel of a mine under Table Mountain, which was owned by his father and where work is still prosecuted. The mortar had been given away to another person, but it has since come into my hands and is preserved in the Museum of the Western Reserve Historical Society of Cleveland.

At the same meeting Mr. George H. Becker of the U. S. Geol. Survey presented a similar mortar found under Table Mountain some years before by Mr. Neale, a mining engineer. Mr. Neale signed an affidavit detailing the particulars, and his remembrance of the situation was so minute that there could be no question of the undisturbed character of the deposits. Mr. Becker well remarks that Mr. Neale's judgment as mining-engineer concerning the undisturbed character of the deposit is the highest evidence that can possibly be obtained, for that is a point to which the miner's attention is constantly directed, on account of the danger attending the opening of any old excavation.

The third new evidence offered was that of Mr. Clarence King, who had just presented to the Smithsonian Institution a fragment of a pestle which he had taken with his own hands, in the vicinity of the two previous places mentioned, from the undisturbed gravel beds underlying Table Mountain. I need not say that Mr. Becker and Mr. King are two geologists of the very highest standing in the country, and that they both have unusual familiarity with the phenomena of that region, and they both, together with Professor Marsh, Professor Putnam, and W. H. Dall, express their unqualified belief in reference to the Calaveras skull that it was found in place in the gravel beneath this same stream of lava.

But I have already made my communication too long. I trust, however, upon your forbearance in publishing it, since the facts are too numerous to be compressed into less space of description, and a volume would be required to give all the evidence in detail. In my book upon "Man and the Glacial Period" I was called upon to discuss a very broad subject in a very small volume, and so could not enter into details. I endeavored, however, to limit myself to facts of which there was abundant proof, if they should ever be called in question. And I would repeat that I am glad of the revival of interest in the subject which will be created by the expression of such doubts as still remain in Dr. Brinton's mind. I have no question but full discussion will dispel the uncertainty that may exist. G. FREDERICK WRIGHT.

Oberlin, Ohio, Nov. 1, 1892.

The Rattlesnake of the Bottom-Lands of Mississippi.

ON August 8, 1891, I received, in a box whose base was about two feet square and whose height was about one foot, a rattlesnake which had been sent by express from Greenville, Miss. The snake was of a stout build, fierce looking and ready to rattle and strike. Through this wooden box had been bored a number of auger holes to supply the serpent with air; these had so weakened the box as to cause a split that afforded some chance of escape.

I thought from its appearance the snake was about four feet long; but after death actual measurement showed four feet five inches in length and eight inches in circumference at the largest part of the body. I had made a longer box with glass top and with a sliding door; through this without much difficulty the snake was transferred from the old box.

The color was an alternation of black spots and light brown ground. The black spots were larger than those of the Mountain Rattler, while the brown was not so bright. This snake had only three rattles when I received it; a careful examination showed that some of the rings had been broken off. I afterwards learned that eight of them were broken off in the express car between Greenville and Winona on the Georgia Pacific road. If this information be correct, the snake had at that time eleven rattles.

When I was endeavoring to make the snake go out of the old box into the new, the glass of the latter was at the side. The snake showed evidence of great irritation and anger; it rattled almost incessantly. Some children were a few feet in front of the glass; at the instant of passing into the new box it struck at the children with all its force, striking against the glass and spattering against it some white, thick, frothy liquid. The snake evidently did not understand glass, not having lived before in a box or house provided with that article. Twice afterwards, when it had been angered, it struck at persons standing a little way in front of the glass; after this it refused to strike, seeming to understand that the glass presented a barrier too great for its strength. The head of the snake trembled from the effects of the blow against the glass. A match struck and lighted in front of the glass seemed to irritate and anger it more than anything else.

I took the precaution to have in the cage a wooden saucer. In this I blew at various times water and sweet milk. I put into the box living frogs, rats, mice, young flying-squirrels, chickens, etc. I also offered to it frequently fresh butcher's meat; but it refused all food; it evidently had no appreciation whatever of any attention or effort to be kind. A young chicken was bitten by it and was dead in twenty seconds; it fell instantly on being struck by the serpent's tooth. Two toads at different times died in the box after remaining therein about six days each. Several times I poured clean water into the box and on the snake; this made it move restlessly; it pushed its nose tremulously against the glass, and, slid it along the glass as if trying to break the glass or find an opening for escape. It seemed to reject water as indignantly as it did food. When lying in the box it seemed to be the perfect expression of sullen disdain.

During October it shed its skin partially. The work of shedding began in the night but it was never perfectly done, parts of the old skin adhering to the sides of the body. During its confinement a new rattle was formed between the former rattles and the body proper, showing thereby that the terminal rattle of the rattlesnake is the oldest.

As time went on the snake became poorer, but the skin was so thick and scaly that the ribs were not visible, and when it was irritated the body was distended to its full former size, either by the drawing and rigidity of the muscles or by inflation. Without food, without water, confined in a box and subject to some considerable variations of temperature, it lived from August 8, 1891, to April 15, 1892, eight months and seven days. During the winter the room in which it was kept often grew cold, but I never allowed it to be cold enough for water to freeze. When in the cold, it coiled closely and seemed torpid; but, on my moving the box into a warm room, it would very slowly uncoil and stretch itself in its box almost straight.

I have heard many extravagant stories about the length of time a rattlesnake could live without food, but I was not prepared to believe that it could live as long as eight months and seven days, until the fact was demonstrated as I have narrated above. Mr. W. W. Stone, the Auditor of Mississippi, who sent this snake to me, informed me it was without food at least a week before I received it. In feats of fasting this animal excels Dr. Tanner and all other human aspirants for that kind of distinction so far as to make their boasts futile. R. W. JONES.

University of Mississippi.

Preliminary Note on Sleep.

THAT there is a relative anæmia of the brain during sleep is well established, but the hypotheses advanced to account for this or any other of the sleep phenomena are unsatisfactory. In "Comparative Physiology and Psychology," 1884, I treated the subject briefly, and since then have been gradually accumulating and arranging data for a theory which I have finally adopted, and which appears to me to be fairly complete as enabling the major phenomena to be accounted for.

Briefly stated, where there is physiological waste there is, normally, repair, and the activities of the brain demonstrably are kept up by renewed nutrition derived from a blood supply adjusted to the ordinary needs. When there is cerebral anæmia, as in chlorosis, then there is increased desire to sleep, the brain does not receive the necessary quantity to compensate waste, and it rests, just as any commercial activity will cease with withdrawal of means to continue it. Those who are familiar with my nutrient reflex theory, mentioned in the book referred to (Professor C. K. Mills of the Pennsylvania University, and Professor C. L. Herrick of the Denison, Ohio, University, have written approvingly thereon), will understand that with cessation of sensory stimulation there will be less blood attracted to the brain and other nerve-centres, the heart-beats lessen in vigor and num-

ber, and, with the pulse-rate full, there is ordinarily less blood in the brain.

Now, it is evident that the anæmia of sleep is not caused by constricted blood-vessels, else there would be the facial pallor seen during an attack of epilepsy, or paroxysm of anger or fright; and with this quieting of the brain-processes by stimuli withdrawal, such as is afforded by darkness, silence, and absence of irritation generally, a further lessening of molecular interchange in the brain occurs; and, I claim that it is the molecular activity in the brain that attracts the blood there chemically and mechanically, and the sympathetic, or vaso-motor system has evolved to facilitate this regulation of demand and supply. Then, granting this, there will be, during sleep, a passive condition of the blood-vessels, and the blood supply will fall to a minimum.

An extension of these considerations will enable all that pertains to sleep to be accounted for, such as æstivation, hibernation, insomnia, dreams, and all derangements of sleep. I hope soon to be able to treat this subject more fully.

S. V. CLEVENGER.

Chicago, Oct. 15.

Solid Glycerine.

IN response to the inquiry of Mr. C. C. Smith regarding the solidification of glycerine, I would say: A mixture of glycerine with water can be frozen at a sufficiently low temperature, and this temperature must be the lower proportionately as the percentage of glycerine is high. Thus, a ten per cent glycerine solution solidifies at – 1° C., a twenty per cent solution at – 2.5° C., a forty per cent solution at – 17.5° C.

Concentrated glycerine will not crystallize when cooled quickly, but at – 40° C. will solidify to a gum-like mass. If a concentrated solution be allowed to stand for some time at 0° C. crystals may form, but not always. The melting-point of these crystals, which are extremely hygroscopic, has been variously determined; and, indeed, their form of crystallization is much in dispute.

Two cases are reported of glycerine having become solidified and crystallized during transport in the cold of winter. The first case occurred in January, 1867, the crystals formed being described as small octohedral, melting at 7.2° C. In the second case, 1876, the crystals are described as belonging to the monoclinic system, and melting at 15° C.

According to Werner, commercial glycerine may be crystallized by bubbling chlorine-gas through it. A method discovered by Kraut in 1870, but to the best of my knowledge not yet made public, is used on a commercial scale in the works at Liesing, near Vienna. The concentrated glycerine is cooled to 0° C., and maintained at that temperature for some time, when crystals of glycerine previously produced are introduced. This causes a crystallization of the entire mass, leaving, however, much of the impurity in the mother liquor. The mass is then placed in a centrifugal, and the crystals freed. These are described as monoclinic, melting at 20° C. to glycerine of 30.5° B. According to Von Lang, the crystals are orthorhombic.

CHARLES PLATT, A.C.

The Vandenbergh Laboratory, Buffalo, Nov. 8.

BOOK-REVIEWS.

Crania Ethnica Americana. Sammlung Auserlesener Amerikanischer Schädeltypen. Herausgegeben von RUDOLF VIRCHOW. Mit 26 Tafeln und 29 Text-Illustrationen. Large 4to. Berlin, A. Asher & Co., 1892. 36 marks.

SINCE the publication of Dr. Morton's "Crania Americana," now more than half a century ago, there has been no contribution to American craniology at all comparable to this work by the acknowledged master of that science in Germany. Future investigators will undoubtedly follow the lines and be guided by the principles here laid down or suggested. Let us briefly see what these are.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Nov. 5.—C. Hart Merriam, The Fauna and Flora of Roan Mountain, N.C.; C. V. Riley, Pea and Bean Weavils; Vernon Bailey, The Influence of the Cross Timbers on the Fauna of Texas; Theobald Smith, On Certain Minute (Parasitic?) Bodies Within the Red Blood Corpuscles.

New Mexico Society for the Advancement of Science, Las Cruces, New Mexico.

Nov. 3.—J. P. Owen, Notes on the Mound Builders; C. H. Tyler Townsend, A Partial Comparison of the Insect Fauna of the Grand Cañon with that of the San Francisco Mountain, in Arizona; Arthur Goss, The Exhaustion and Renewal of Soils; C. T. Hagerty, Mathematical Computation of the Comparative Strength of Insects and the Higher Animals.

Publications Received at Editor's Office.

BUBIER, E. T., 2nd. Questions and Answers About Electricity. New York, D. Van Nostrand Co. 16°. 100 p. Ill. 50 cts.
CHURCH, ALFRED J. Stories from the Greek Comedians. New York, Macmillan & Co. 12°. 350 p. Ill. $1.
CROCKER, F. B., AND WHEELER, S. S. The Practical Management of Dynamo and Motors. New York, D. Van Nostrand Co. 12°. 100 p. Ill. $1.
FERREE, BARR. Comparative Architecture. New York, The Author. 8°. Paper. 15 p.
GALTON, FRANCIS. Hereditary Genius. 2d ed. New York, Macmillan & Co. 8°. 411 p. $2.50.
HIORNS, ARTHUR H. Metal Coloring and Bronzing. New York, Macmillan & Co. 16°. 352 p. $1.
HUDSON, W. H. The Naturalist in La Plata. London, Chapman & Hall. 8°. 392 p. $3.
SLOANE, T. O'CONNOR. The Standard Electrical Dictionary. New York, Norman W. Henley & Co. 12°. 624 p. $3.
SPEAR, MARY A. Leaves and Flowers. Boston, D. C. Heath & Co. 12°. 108 p. 30 cts.
UNIVERSITY OF PENNSYLVANIA. Contributions from the Botanical Laboratory. Phila., The University. 8°. Paper. 72 p. Ill.

Dr. Virchow aims in the first place to establish a series of cranial ethnic types as the foundation of ethnic classification. Here, very much depends on the sense in which a "type" is understood. For him, it is the sum of those traits which belong to the crania of a given ethnic division, excluding, on the one hand, traits which are individual, and, on the other, those which are generic. Theoretically, it is the expression of the ethnic law of hereditary development, which, independently of outward circumstances, controls bodily growth. It must be defined by a series of exclusions and averages.

Each of the "types" which he figures is represented with the utmost fidelity in five different positions, showing the following norms: norma frontalis, occipitalis, temporalis, verticalis, and basilaris. All are represented from the points of view of the "German horizontal," which is a line drawn from the superior point of the external auditory foramen to the lower margin of the ocular cavity. This method of iconography is in itself worth a particular study, and no exception can be taken to its accuracy and its superiority to those heretofore in use.

Close attention is given to artificial deformations of the skull, which were numerous and widespread among the American aborigines. Eight leading varieties are classified and their effects analyzed. It is shown that by laws of compensatory growth such deformity does not entail diminished cubical capacity. The lowest capacity, 1,100 cubic centimeters, was in a normal skull from Chile; the highest, 1,880 cubic centimeters, was in a Labrador Eskimo.

The general conclusions reached by this masterful study will interest every one. In the first place, Dr. Virchow denies that there is any one characteristic aboriginal American type of skull, or, so far as one can see, that there ever has been one. The salient traits, none of which is peculiar to the race, are the os Incæ, which is an arrest of development; the absence of the temporal process, the presence of which is a pithecoid trait; exostosis of the meatus auditorius, which must be regarded as pathological; and certain changes in the alveolar and malar bones, largely due to function. Finally, the conclusion is reached that the lowest known forms of the human skull have no counterparts in any yet discovered in America, and therefore we must at present draw the inference that such types did not exist there, and that the oldest history of the human species will not be enlightened by any discoveries in the New World. Man came to America as an immigrant, physically highly developed, and doubtless in a condition of culture corresponding thereto.

This brief outline gives but a faint idea of the riches offered in Dr. Virchow's introduction, which is written, moreover, in that lucid and vigorous style of which he is such a master, and which is in such happy contrast to most German scientific composition. There are, however, a few points where the work is open to question. The reference on the first page to the inferior value of linguistic grouping carries with it its own condemnation; for where there is mixture of languages there is invariably mixture of blood, and hence of cranial types as well. Bones cannot guide us better than roots in such interminglings. In several of his "types," the history is sadly incomplete. Thus, Plate xv. shows a "Mexican" skull; but to say "Mexican" is every whit as vague as to say "European;" and what guarantee have we that its peculiarities are not individual instead of ethnic? This observation applies to several other of the crania figured. According to his own definition of type, such specimens can have but very doubtful value. In the text to Table xx. it is assumed that a prominent frontal protuberance is a proof that the skull belonged to a male. Do other anatomists concede this? But criticism is disarmed by the candid statement of the author that the material at hand was far from sufficient to reach the point he desired, and that his work must be regarded rather as a preliminary contribution to the study of this wide and important field. This it is, in the best sense of the word.

D. G. BRINTON.

SCIENCE

NEW YORK, NOVEMBER 18, 1892.

CONTRIBUTION TO THE ETIOLOGY OF BERI-BERI.[1]

BY ALBERT S. ASHMEAD, M.D., NEW YORK.

THROUGH the courtesy of Captain J. R. Durke, of the bark "H. B. Cann," whose crew were prostrated by beri beri in the tropics, two of them dying of the disease, and of Messrs. Edward Hincken & Son, the consignees of the cargo, I have been enabled to extract the following data from the ship's log-book, to which I add some informations otherwise imparted. The bark (registered 1,299 tons) sailed April 27 from Ilo-ilo, Philippine Islands, with a cargo of raw sugar, 70,284 sacks. Let me say that this is a considerable freight, for a sack amounts to 66 pounds, which gives a total amount of over 2,300 tons! The sugar was mostly No. 3, the lowest grade, and the most liable to fermentation.[2] Fermentation in such a mass of sugar must have set free an enormous quantity of gases. Her crew consisted of fifteen men. On May 22 bad weather set in; there were 18 inches of water in the well in 12 hours, a condition which necessitated pumping every two hours. On June 5, heavy squalls, the bark ships large quantities of water; this weather continues until the 20th. Even when the squally weather has ceased, the pumps are worked every two hours. On July 15 a terrific storm strikes them, and continues until July 20. The decks for 24 hours were continually filled with water. A strong south-west current (60 miles an hour), lasting many days, set in. I observe here that it is generally supposed that there is a connection between the south-west winds and beri-beri. But the current called south-west is the current naturally due to the emptying of the waters of the Indian Ocean into the South Atlantic, around the Cape of Good Hope. It flows, therefore, toward the south-west and not from the south-west. In fact, throughout the voyage the bark never met the south-western trades. The following data show that the bark had less to deal with trade-winds than vessels usually do. When she left Ilo-ilo April 27, the north-east monsoons were becoming very weak; they carried the ship to the Basilan channel. The captain tried to get through Macassar Strait, but the wind was too weak; so he changed his course, and came down, with variable winds, Molucca passage. He was 45 days getting free of the East Indies into the Indian Ocean, through Lombock, an extraordinarily long passage. He had south-east trades, strong and squally, to Port Natal. He had 10 days' hard weather around the Cape of Good Hope, three days of which there was a heavy gale. From the Cape of Good Hope he had variable winds and calms until he struck the south-east trades in the South Atlantic (Aug. 7), which carried the ship past the equatorial line, 3° north latitude. Then he had calms and doldrums to Sept. 11, at which date, latitude 9° 39′ north, longitude 44° 21′ west, he found south-east winds prevailing instead of the usual north east trades, which he should have met here. These carried him to the North Atlantic and to port. Considering these facts, and the comparatively violent outbreak of beri-beri on the vessel, we must conclude that the etiological importance of the south-west trades in beri-beri has been very much exaggerated, if it is not altogether imaginary. Of course they have clearly an influence, inasmuch as they bring wet and heavy weather, which wet and heavy weather would be, I think, as innocent as the winds themselves if the really toxic action of carbonic emanations was absent.

Bodily exhaustion has always been considered as an etiological factor in beri-beri. Here is added, what, as I just said, is in my opinion, a much more important factor, the influence of carbonic gases. One month after they left Ilo-ilo, the water got into the hold, and the sugar began to ferment. Strong and stifling fumes permeated the vessel, which continued until she got into still water at Norfolk, Va. On Sept. 8 (this happened — the observation is not without its bearing — in latitude 2° 40′ north, longitude 41° 28′ west, near St. Helena, 139 days from the Philippines, the 111th day of the fermentation, on the very edge of the range of the trades) Russell, a seaman, was laid up with swollen limbs; he died Sept. 23. The pumping, meanwhile, continued every two hours. On Sept. 16 (latitude 13° 27′ north, longitude 52° 14′ west) the carpenter was laid up with swollen feet. Sept. 25 Andrew, Sept. 26 Peterson, Sept. 27 Kemp, seamen, were afflicted likewise. The carpenter died Oct. 9. At this date all were more or less ill, except four. The work at the pumps was being continued with fewer hands. A signal of distress was hoisted Oct. 10. There got then 5 inches of water into the well every two hours. Oct. 11 (167th day of the voyage) the tug Rescue came to the relief, took the bark in tow to Hampton Roads, where six men sick of beri-beri were left in the hospital. A new crew was enlisted, and the vessel, having been well pumped out, was towed to New York harbor. It has been said somewhere that there had been a famine on board and a scarcity of water. This, says the captain, has not been the case. They had plenty of water, as appears by the following notation in the log-book: May 20, Filled up starboard water-tank on deck. Aug. 30, Put about 150 gallons of water into the starboard tank. Sept. 16, Saved about 300 gallons of water. Sept. 19, Five feet of fresh water in the tank. And the water was good throughout. Vegetables were the only thing wanting, and rice and ship's bread (hard tack) were plentiful. They had Australian beef, of which they had broached seven casks (a cask is 300 pounds), and one cask of pork (200 pounds). I extract again from the log-book the following insertions to show how far a cask of beef goes: April 27, broached a cask of beef; May 17, beef; May 29, pork; June 8, beef; July 5, beef; Aug. 17, beef; Sept. 14, beef; Oct. 3, beef. It is just a little inferior to American beef. Besides the salt meat, the men had twice a week fresh beef packed in tins, also lime-juice every day, and fresh wheat bread baked every day. The ration table was that required by the English Marine Service.

The crew consisted exclusively of Europeans, the captain himself is a Nova Scotian, and the bark flies the English flag. The disease undoubtedly was beri-beri, so I hear from Surgeon J. C. Perry of the United States Marine Hospital Service, Norfolk, Va. Being English, the patients were placed in charge of Quarantine Medical Officer Dr. W. A. Thom, Jr. All of them have now recovered. One of them, the first mate, reached New York by rail and met the ship at her arrival. There had been eleven men sick; four had resisted, the captain, aged 40; a Londoner, aged 25; the steward, a German, aged 60; and the second mate, an Englishman, aged 35.

I extract from the log-book: Oct. 9, Andrew and Peterson both still laid up, which makes it very hard for the rest of us. It takes all hands to take in top gallant sail, or in fact do almost anything, as we are getting weak from this sickness that has overtaken us. More water than usual coming to the pumps. Mill going almost all the time. Monday, Oct. 10, There are now three men laid up, and we have to-day finished the last of our provisions. The remaining of us are more or less affected by this sickness. It is as much as we can do to pump ship with all hands. Hoisted the signal P.H. to a steamer; apparently he took no notice of us. Five inches of water in the well every two hours. Observe that the victuals gave out only the day before they touched port.

I myself visited the ship and inspected the sleeping apartments of the men. The forecastle is on deck; it has twelve bunks in a room 15 feet long, 10 wide, 7 high; doors and a scuttle give free ventilation. The bunks were tight-boarded pens and, of course, would hold gases.

[1] Communicated to the Sei-I-Kwai, or Society for the Advancement of Medical Science in Japan.

[2] The fact that the cargo in question came from Ilo-ilo to the United States shews it to be of the lowest grade. The Philippines send us but their meanest wares, strange as that may be, and for some unknown reason always from Ilo-ilo. Nos. 1 and 2 go to Germany and England, always from Manilla.

The ship's carpenter, who died, slept by himself in the store-room; his was a closed bunk, like all the others. The first mate slept alone off the mess-room, in the after part of the ship; he contracted the disease.

We have then here the following situation: Toxic matters in the atmosphere, either directly by the fermentation of an enormous mass of sugar[1] and the formation of the poisonous compounds of carbon, or by a decomposition of the air depriving it of part of its oxygen. We have a wet trip, the very weather in which beri-beri, or kakké, flourishes in Japan. We have muscles and peripheral nerves more or less exhausted by the pumping work rendered necessary by the leak.

We have, therefore, an image of the disease, accompanied in the most manifest way by all its etiological factors, which leaves nothing to be desired.

The following facts relating to the export of sugars will perhaps be of some interest. Captain Durke tells me that all sugar cargoes in the voyage blacken the paint;[2] he says, however, that unless water gets into the cargo the sugar will not really ferment. He has carried many cargoes from the West Indies, the Barbadoes, and all gave off the blackening gas; but he had never a ship ferment before, nor had he ever an outbreak of beri-beri. Therefore the fermentation is not the cause of the formation of that sulphuretted hydrogen. The elder Mr. Hincken, a sugar broker, one of the consignees, says he has many times entered the holds of incoming sugar ships and always found them sweating from the heat in the hold. It must be noted that in the East Indies lime containing sulphur[3] is used in the preparation (tempering) of sugar for export to prevent fermentation; hence the blackening gases. In the preparation of the cane-juice for export sugar in the Philippines no molasses is formed. This is the only difference in preparation between it and West Indian sugar; in the latter there is always a formation of molasses. It is the addition of an excess of lime to sugar which prevents the formation of molasses, by the more abundant production of saccharates; hence, if the lime is very sulphurous, we naturally have an excess of sulphuretted hydrogen developed. The sulphuretted hydrogen, if you consider these data, can have nothing to do with the disease; it blackened the walls, that is all. The captain has had walls blackened frequently without beri-beri. One question in passing, Why did beri-beri never occur in any ship exporting sugar from Brazil and the West Indies? The cause may be that the trips of these vessels are comparatively short. Moreover, peculiar care is taken of the Brazilian sugar, for it is known to be a very poisonous stuff; that is, to ferment very easily.

Each of the facts mentioned above; that is, emanations of carbonic compounds, exhaustion, tropical wet weather, may not by itself produce beri-beri. But here we have them united, and their union is strong enough to overcome the resistance of Europeans.

I have elsewhere affirmed my belief in the operation of carbonic compounds in the production of kakké in Japan.[4] I think that I have a right to consider this case as strongly corroborating my theory. Dr. Takaki, while admitting the action of the carbonic compounds, supposes them to act in a quite different way from that in which they have evidently acted in this case. He believes carbonaceous food to be the cause of the intoxication. Here the effect was produced by inhalation; this is evident by the indisposition of the ship's dog. That animal, as well as the four men who had not contracted beri-beri, was continually vomiting. If the gas operated to make these beri-beri-free men sick, and it was undoubtedly the gas, it was by being inhaled. Now why should the gas not have produced the disease in the others in the same manner; that is, by inhalation? This does away with the theory of beri-beri intoxication through carbonaceous food.

Dr. Takaki claims to have eradicated kakké, which is the same as European beri beri, from the Japanese Navy, by the elimination of rice from the diet of the men. That he has eradicated it, I believe. But that it is due entirely to the change in the diet, I do not believe. The men have been at the same time removed from the influence of those fumes of carbon, amidst which the Japanese live and breathe. In Japanese houses charcoal is continually burned for heating and cooking, and the natural humidity of the hot season keeps over everything a deep layer of pernicious gases. In the new navy the men are not exposed to the same influences, their heating being done by steam or coal. The fact that the removal of the beri-beri patients to higher altitudes, where the air is pure, results in improvement is proof positive that the poison is inhaled. This fact, that is, the advantage of altitude, must remind most readers of that unfortunate Neapolitan dog, who inhales the oxide of carbon of the "cave of the dog," for the instruction and amusement of the visitor. The gas, which in this grotto issues from some fissures, is so heavy that it remains in the inferior part of it, and does not reach the nostrils of men; but the dog, breathing in the nether layers, falls down at once in a paroxysm of asphyxia.

It is my opinion, if similar changes in the heating methods to those which were introduced into the navy, were adopted by the people at large the benefit conferred on the navy would become a general, a national one. They have only to stop the burning of charcoal.

That Europeans in Japan rarely contract beri-beri is partly explained by the fact that they are not exposed to charcoal fumes in their houses.

However I do not contend that inhalation of carbonic gases, is the only etiological factor of beri-beri. These factors are necessary: Weakness, produced, on the one hand, by a feeble non-albuminous diet, incapable of maintaining the natural resistance of the body to morbid influences, or by climatic or other like influences,[5] debilitating the muscular fibres and peripheral nerves, and *the toxic influence itself*, that is, the presence of carbonic gases when it continues for a sufficient time.

ORIGIN OF THE LINES OF MARS.

BY PROFESSOR HENRY W. PARKER.

On examining a copy of Schiaparelli's Map of Mars, May, 1889, I called the attention of the geology class of Iowa College to the striking general coincidence in the direction of the lines with those of coast and mountain trends on the earth, and I referred to the observations on these by Professor Benjamin Peirce, and a suggested explanation by Professor James D. Dana. The coincidence must have occurred to many persons; but I find no reference to it except in a paper by the younger Darwin (G. H. Darwin) read before the Royal Society in 1878, and printed in the "Transactions," to which, as dealing with coast-lines, I was recently referred by Professor Wolcott Gibbs and by S. C. Becker of the U. S. Geological Survey. Mr. Darwin's remarks were founded on a previous and probably much less detailed map of Mars in "Appendice alle Memorie della Societa degli Spettroscopesti Italiani," Vol. VII., 1878. His papers (in Parts 1 and 2 of "Transactions," Vol. 170) relating to terrestrial physics are "On the Bodily Tides of Viscous and Semi elastic Spheroids, and on the Ocean Tides upon a Yielding Nucleus," and "On the Precession of a Viscous Spheroid, and on the Remote History of the Earth."[6] In the latter paper, referring to the dragging of tidal protuberance greater at the equatorial regions than at the polar, and the consequent distortion of a yielding globe, he says:

"The screwing of the earth's mass [as a viscous spheroid in remote ages, his meaning seems to be] varies inversely as the sixth power of the moon's distance multiplied by the angular velocity

[1] 10,000 sacks out of 50,000 up to this time unloaded have been involved in the process, and it is expected that about one-third of what remains in the bottom of the bark will be found damaged; that is, about one-fourth of the whole cargo, 500 tons, has suffered.

[2] The ship's paint was black from sulphuretted hydrogen. I tested some of it.

[3] In the Icery process, bisulphite of lime is used.

[4] Univ. Med. Mag., January, 1891. Sei-I-Kwai Med. Journ. XI., No. 2.

[5] The temperature in the ship's cabin, during the entire voyage nearly, was over 80°; in the sun, in the Indian Ocean and tropics, it was as high as 126°. In Japan, kakké occurs in the season when the sun is very hot and the air very damp, and the days when these conditions are particularly oppressive, the patients are regularly worse.

[6] For some pertinent comparisons between the physics of the earth and of Mars, with special reference to the state of internal stress of an elastic sphere under tide-generating forces, but with no mention of the lines of Mars, see Mr. Darwin's paper, "On the Stresses caused in the Interior of the Earth by Weight of Continents and Mountains," in the same "Transactions," Vol. 173.

of the earth relatively to the moon. And, according to that theory [in the first paper], in very early times the moon was very near the earth, whilst the relative angular velocity was comparatively great. Now, this sort of motion, acting on a mass which is perfectly homogeneous, would raise wrinkles on the surface which would run in directions perpendicular to the axis of greatest pressure. In the case of the earth, the wrinkles would run north and south at the equator, and would bear away to the eastward in northerly and southerly latitudes, so that at the north pole the trend would be north-east, and at the south pole north-west. Also the intensity of the wrinkling force varies as the square of the cosine of the latitude, and is thus greatest at the equator and zero at the poles. Any wrinkle, when once formed, would have a tendency to turn slightly, so as to become more nearly east and west than it was when first made.

"The general configuration of the continents (the large wrinkles) on the earth's surface appears to me remarkable when viewed in connection with these results. There can be little doubt that, on the whole, the highest mountains are equatorial, and that the general trend of the great continents is north and south in those regions. The theoretical directions of coast-line are not so well marked in parts removed from the equator.

"The great line of coast running from north Africa by Spain to Norway has a decidedly north-easterly bearing, and the long Chinese coast exhibits a similar tendency. The same may be observed in the line from Greenland down to the Gulf of Mexico; but here we meet a very unfavorable case in Panama, Mexico, and the long Californian coast-line.

"From the paucity of land in the southern hemisphere, the indications are not so good, nor are they very favorable to these views. The great line of elevation which runs from Borneo through Queensland to New Zealand might perhaps be taken as an example of a north-westerly trend. The Cordilleras run very nearly north and south, but exhibit a clear north-westerly twist in Tierra del Fuego, and there is another slight bend of the same character in Bolivia."

After speaking of his theory as in accordance with the views of geologists, so far as they hold that the general position of continents is what it was from the first, Mr. Darwin remarks:

"An inspection of Professor Schiaparelli's map of Mars (1878), I think, will prove the north and south trend of continents is something [not] peculiar to the earth. In the equatorial regions we there observe a great many very large islands separated by about twenty narrow channels running approximately north and south. The northern hemisphere is not given beyond latitude 40°, but the coast-lines of the southern hemisphere exhibit a strongly marked north-westerly tendency. It must be confessed, however, that the case of Mars is almost too favorable, because we have to suppose, according to the theory, that its distortion is due to the sun, from which the planet must always have been distant. The very short period of the inner satellite shows, however, that the Martian rotation must have been (according to the theory) largely retarded; and where there has been retardation, there must have been internal distortion."

The later map (*Popular Science Monthly*, 1889) after Schiaparelli's observations in 1888, gives the Martian surface from 70° north to 70° south. The number of lines, including those of so-called islands and coasts, running north-easterly, are about equal to those running north-westerly; although, east of 280° longitude the lines are most strikingly north-westerly for about half the surface of the planet, as any one can observe, inverting the map to bring the north to the top, and the west to the left hand (see "Septentrio" and "Occidens" printed in the border of the map).

Beginning with the west, the longest north-west lines (all double) and their angles with the equator are as follows, indicated by names connected with them: Oreus, 20°; Pyriphlegethon, 47° to 50° (both continued on the east in the map); Hydractes-Phlegethon, 24°; and Antæus-Eunastos, 40°, with virtual long continuations extending it from 40° south to 60° north. The mean inclination of these four is about 34°; and a striking fact is that two are 20-24°, and two 40-45° nearly. The mean of ten most noticeable north-west lines, double or single, is about 42° 44'.

The longest north-east lines, also double, are Gigas, the inclination changing from 40° on the south of the equator to 30° on the north; Phison, 45°; and Erebus-Cerberus, somewhat curved, 25°; of great length, and continued as a single line east through not less than 150° of longitude. The mean is about 43°, excluding the double Jumana, 75°. Twelve conspicuous north-east lines, single or double, have a mean inclination of nearly 50° 45'. A few others are north and south, or so nearly so as to be counted such.

For comparison, a map of the earth on Mercator's projeection must be taken. The mean of ten of the most noticeable north-western trends of coast, mountain, or depression is 60°, as against 42° 44' in Mars. The mean of fourteen north-east is about 46° 25', as against 50° 45' of the twelve above mentioned in Mars, — a striking similarity. The great features, running north and south, are few, as in Mars; viz., the southern Andes, the Ural Mountains; and the less-known chain of eastern Africa.

Mr. G. H. Darwin's theory is, so far as known to the writer, the best one for the earth, and the only one fairly worked out, though, as Mr. Darwin acknowledged, it is poorly consistent with the earth's great north-west lines, and is seemingly opposed to the tidal probabilities of Mars, which has two small but near moons of different revolution. It would be exceedingly interesting if some mathematical astronomer would work out the complicated problem of the tides of Mars (perhaps considerable at conjunctions) on the supposition that its surface was all water. But Mr. Darwin partly dismisses the moons, and refers to the action of the sun, which, however, he thinks must have been inconsiderable. This reference is curiously coincident with a reported suggestion by the late Professor Benjamin Peirce that our continental trends might be due to the "action of the sun." I cannot get from his son, through a friend, any reference to a record of his view; only that in a perhaps unpublished paper, or on some occasion, he called attention, as everyone knows he did, to the remarkable fact that the continental trends are great circles of the sphere tangential to the arctic and antarctic circles, — a fact with some striking illustrations, but not universal. Professor Dana credits the first observation of this to Robert Owen, in his "Key to the Geology of the Globe," 1857.

Professor James D. Dana suggested that the great lines of the earth might be due to a system of cleavage comparable to that of crystals.[1] He refers to parallelism observed in the crystals of a solidifying mass, but does not give particulars. In some crystalline rocks, e. g., gneiss, the parallelism conforms to layers of deposit, and here and in other instances may also have to do with pressure. How it is in respect to unstratified metamorphic rocks is a question to be determined by observation. There is one fact on a limited scale that may have some weight; it is that, in cavities and fissures, implanted crystals have been observed to have uniform alignment to the horizon and points of compass,—similar faces of like crystals flashing simultaneously in the light. The importance of this fact, so far as it holds true, is that the arrangement must depend on some other force than molecular attractions; it may be from a very far-reaching cause, sufficient to produce lines of weakness, here and there, that became concurrent. Perhaps we shall have to fall back provisionally on that fetish of the ignorant and the semi-scientific, "electricity," supposed to explain everything from a tornado to a nervous twinge. In this case it might have a color of possibility, if it be true that

[1] "Cleavage Structure in the Earth's Crust.—The prevalent north-east and north-west courses of trends, the curves in the lines varying the direction from these courses, and the dependence of the outlines and feature-lines of the continents and oceanic lands upon these courses (p. 29) are the profoundest evidence of unity of development in the earth. Such lines of uplift are lines of fracture or lines of weakest cohesion; and, therefore, like the courses of cleavage in crystals, they show by their prevalence some traces of cleavage-structure in the earth, — in other words, a tendency to break in two transverse directions rather than others.

"Such a cleavage-structure would follow from the mode of origin of the earth's crust. The crust has thickened by cooling until now scores of miles through; and very much as ice thickens — by additions to its lower surface. Ice takes a columnar structure, perpendicular to the surface, in the process, so as often to break into columns on slow melting. The earth's crust contains as its principal ingredient one or more kinds of feldspar, all cleavable minerals; and, as crystals on slow solidification often take a parallel position, so it might have been in the cooling crust. This appears the more probable when it is considered with what extreme slowness the thickening of the crust has gone on, and the immeasurable length of time it has occupied."—Dana's "Manual of Geolcgy," 1876, pp. 737-8.

earth-currents have anything to do with such dispositions of matter as the renewed deposit of ores asserted of certain dry mines and tunnels; but no rock-bed, probably, is dry enough to demand such an explanation, which itself requires a great deal of explaining.

In this connection I will add that a hexagonal crystallization in Mars, occurring to the mind of one of your correspondents, is as wild as the canal idea. The radiating lines are on too vast a scale; and there is nothing in any known crystallizations to favor the idea, unless it be the little six-rayed stars of frost spicules, from which the jump to Martian continents is too great. The radiations have their counterpart in the old volcanic surface of the moon and some analogous facts on the earth; also in mountain system "knots," Himalayan or other.

On the whole, the action of lunar and solar tides on planets while in a viscous condition, with more or less crust, is the only hypothesis that so far promises well, in explanation of the remarkable lines of the earth and Mars, notwithstanding the difficulties mentioned.

Yonkers, N.Y., Oct. 27.

RESIDUAL PERSONALITY.

BY ARTHUR E. BOSTWICK, PH.D., MONTCLAIR, N. J.

EVIDENCE is not wanting to show that what we call personality is an extremely complex thing, the sum of subsidiary personalities which now shift and change like the figures in a kaleidoscope, and again, becoming sharply defined under some abnormal condition, crystallize into two or more distinct groups of elements, which alternately sleep and wake or even co-exist. These complex elements may be so unstable, the groups composing them constantly breaking up and forming new combinations, that the idea of multiple personality does not naturally attach itself to them; it is only when they become stable, and especially when each exhibits a well-defined consciousness, that we begin to think of such a thing. But, besides the abnormal and diseased conditions which cause such a separation or crystallization, there are other conditions in which it appears somewhat less distinctly. To one class of these I desire to call attention very briefly — to that embracing what may be called cases of residual personality.

Residual phenomena of all kinds are particularly interesting and instructive, especially those where the few things remaining in a group after many have been removed differ widely in their collective properties from those that have been taken away, while these latter are not in any way distinguishable from those of the sum of both before the division. This is the case often with residual personality. Nothing is more common than for a group of elements in what we call a person to be differentiated in one of various ways, leaving behind a residual group differing altogether in its characteristics, though the differentiated group represents to us, and is indeed considered to be identical with, the original person.

The commonest method of such differentiation is sleep. The elements which sleep, are, as it were, subtracted from the normal personality, but there is usually left behind a very curious something — illogical, credulous, fantastic — whose nightly experiences the whole re-united person recollects in the morning as dreams. The next commonest case is that of the absent-minded person. The major part of the person being absorbed in mental processes of some sort, the residual person lives its own separate mental life, thinks, feels, and wills by itself, and perhaps carries on a train of processes which is continuous with a preceding train carried on under similar circumstances the day before. This residual person may act very mechanically; the re-united person may fail to recollect what its acts or thoughts were and be surprised to find how it has been making use of his limbs while he — what he vainly regards as the one unalterable ego — has been absorbed in thought; but, on the other hand, it may be perfectly conscious, and may carry on an entirely different train of thought of its own. Almost always, however, it is eccentric, and betrays a weakness at one point or another.

For instance, a suburban resident, whom we will call A, is accustomed on landing at the New York side of the ferry to abandon the mechanical task of walking to his office entirely to his residual personality, and to give up the major part of himself to thought. The two personalities act often with perfect — always with practical — separateness, the residual person being quite equal to the low task of evading vehicles, steering clear of passers-by, and turning the proper corners. When the office is reached and the two persons again become one, it is often a difficult task to remember any circumstances of the walk. On one occasion, however, A left the Astor Library on Lafayette Place, as he supposed, intending to walk down Clinton Place. To do this he must turn first to the left, then to the right, and then again to the left. He turned once to the left, and after some time became dimly conscious that he had walked for a long time, and that the place for the second turn had not been reached. Coming to himself, he found himself far down Broadway. Tracing back his course mentally, he discovered that he had been in the Mercantile Library instead of the Astor; his first turn therefore had taken him down Broadway, and he of course did not reach the place for the second. Mark now the peculiarities of his residual person. It knew just where it was to turn and in what direction, and had sense enough to be uneasy when it did not come to the proper place to turn, but it had not intelligence enough to know that it was on the wrong street. Its mind was too weak to be trusted further than it was accustomed to go. This residual person, in short, was about on a par with a harmless idiot.

Again, B, a New Yorker, is walking along absorbed in a process of thought, when his residual personality sees his friend C approaching. It is not astonished, for he is near C's lodgings, but as the person supposed to be C comes nearer, it sees that he only slightly resembles C; he has on shabby clothes, and his face is entirely different. The natural conclusion would be that the person approaching was not C. The residual person, however, does not argue thus. It concludes at once that C has greatly changed; that he has become poor, and that his appearance has altered for the worse. Pity and surprise are plainly felt by the residual person. During these mental processes, so similar to those of a dream-residual, the major person has kept on with his own train of thought. Finally, however, on the close approach of the supposed C, they unite in a flash into the normal person, the two separate consciousnesses become one, and the truth is recognized at once. No doubt these cases can be paralleled by thousands of others. It seems to me that they are as true instances of double personality as any exhibited by epileptic or hypnotic persons.

Why should the residual person differ so from the normal, while the differentiated person is precisely like the normal? If we take 199 gallons of water from 200, is not the remaining gallon still water? There are many mathematical analogies. In geometry, if we draw a parallel to the base of a triangle we thereby cut off a precisely similar triangle, yet what is left has no resemblance to a triangle. This analogy, carried out, would point to a consideration of personality as a function of position or arrangement of elements, as chemical isomers are functions of the position of their constituent atoms. But an algebraic analogy, which ties us down to no such hypothesis, probably comes nearer the truth. Consider the identical equation $(X + Y) - (a X + b Y) = (1 - a) X + (1 - b) Y$. If $a = b$, the ratio of the two terms of minuend, subtrahend, and remainder, each $= \frac{X}{Y}$. But if a and b differ very little from unity and from each other, then $\frac{a}{b}$ may be sensibly unity, while $\frac{1-a}{1-b}$ differs greatly from it, and thus the ratio of the terms of the subtrahend will be sensibly that of the terms of the minuend, while that of the terms of the remainder may differ greatly from both. In the same way, by extending the number of terms, we may subtract from any polynomial what is sensibly a sub-multiple of it, and yet leave a remainder whose terms bear a very great disproportion. Hence it is, no doubt, that the removal of a group of elements of personality that seems to represent one's normal self may leave a residue so different and so incongruous.

It will be observed that what has been said is entirely independent of any hypothesis as to the nature of the elements of personality and the mode of their combination.

CURRENT NOTES ON ANTHROPOLOGY.—XIX.

[*Edited by D. G. Brinton, M.D., LL.D.*]

[Dr. Brinton has been appointed, by the President, a commissioner to represent the United States at the Columbian Historical Exhibition in Madrid, and will be absent from the country about two months. One more instalment of these notes will appear before his return.—ED.]

The Congress of Criminal Anthropology.

THE third International Congress of Criminal Anthropology was held in Brussels Aug. 7–18, and resulted in a decided advance in this extremely valuable branch of science. Although Professor Lombroso of Turin, who is looked upon almost as the father of the subject, was absent, and indeed the whole of the Italian contingent — disgruntled, for some reason, it was alleged — stopped away, yet there were very active discussions and a very marked change of base in regard to the physiology of the criminal classes.

Those who have followed the French and Italian writers are aware that they have taken great pains to define the "criminal type." It has been alleged that habitual criminals have a lower average cerebral capacity than others; that their foreheads are retreating, and their brain developed posteriorly; that their lower jaws are strongly pronounced and their ears frequently deformed; their hair thick and coarse, but their beard scanty; and so on. Such was the "criminel né" of the French, the "uomo delinquente" of the Italians. But the Brussels Congress may be said to have upset all this interesting theory. Dr. Tarnovski of St. Petersburg and Dr. Naecke, from a very wide collation of observations, denied any special physical peculiarity in criminals, either male or female.

The tendency of all the leading speakers was to look upon crime as the result of psychical and social rather than physical peculiarities. It is true that physical abnormalities are more frequent in the criminal class, but there is no constant relation between any one of them and crime. Very many criminals have an inherited tendency to some form of mental alienation; many others owe their character to purely personal and social influences of a deleterious character. Society is far more to blame for their existence than has hitherto been acknowledged; and if the tide of crime is to be stayed, we must have recourse to sounder moral instruction, more judicious systems of legal procedure, and an improved doctrine of punishment. This is the important practical lesson taught by the Brussels Congress.

The next Congress was fixed for 1896, in Geneva.

Shape of Sclavic Skulls.

In connection with the article on this subject contributed to *Science*, Oct. 28, by Dr. John Beddoe, I may refer to the measurements of Czech skulls, from villages of pure blood in Bohemia, by Dr. L. Niederle, published in the June issue of the *Mittheil. der Anthrop. Gesell. in Wien.* He found them decidedly brachycephalic, averaging about 85. the skulls of women being more so than those of the males. They were also leptoprosopic, mesorhinic, and hypsicephalic. These peculiarities correspond closely to those noticed in the living population of Bohemia, especially where of pure Sclavic blood. Most of the school-children are broad-headed, more markedly so than the adults. They lose in a measure this trait on growing to adult years. The dolichoid form is distinctly more frequent and pronounced in living men than in women, even in the same village and of the same family.

Linguistic Affinities of the Ancient Coptic.

In a memoir prepared for the tenth session of the International Congress of Orientalists, Dr. Carl Abel presents a summary of the evidence which he has been industriously collecting for years to prove the etymological relationship of the language of ancient Egypt with the Indo-European stock. It is an extremely intricate subject, and to many his methods will appear strange, and at first sight repellant. He claims, for instance, that a primitive radical often has two meanings which are the precise opposites of each other, as "good" and "bad," or "white" and "black." Again, that such a radical was frequently reversed in its sounds, for example, that *rak* and *kar* are the same word, the one being read and originally pronounced backwards, but both are to be construed as the same root. He also presents a series of substitutions in sounds, one organ occasionally taking the place of another in utterance, according to definable laws.

These novelties to old-fashioned students of Aryan and Semitic tongues have not aided to make his views popular; but they have been accepted by such distinguished scholars as Professor Maspero of Paris, Professor Harlez of Brussels, and Professor Sayce of Oxford, as throwing a new and valuable light on the phonetic laws of ancient Coptic. If European scholars would study more diligently the aboriginal tongues of America, they would learn that all these, and various other linguistic processes of which they seem to have very faint comprehension, are part and parcel of the natural development of human speech.

Pre-Columbian Migrations in America.

In the October number of the Proceedings of the Royal Geographical Society, Judge E. F. Im Thurn has an instructive article on British Guiana, giving much fresh information about the economical conditions and gold-diggings there. At its close, he speaks of the native population, and indulges in some speculations as to the origin of the Caribs and Arawacks, who at the time of the discovery inhabited the West Indian archipelago and the northern shores of South America. He maintains that both these nations migrated from the northern continent, following the chain of islands till they reached the southern mainland, where the Caribs located to the east of the mouth of the Orinoco and the Arawacks to the west. The Warraus he believes to have been the antecedent occupants of the region.

As Mr. Im Thurn has written much and well on the Indians of Guiana, I feel called upon to state that there are no facts which justify the theory here advanced, and that every evidence points unequivocally in the opposite direction. Both Caribs and Arawacks unquestionably came from the interior of the South American continent and moved northward, the Arawacks reaching as far as the Bahamas, where Columbus found them, while the Caribs had no permanent villages north of Jamaica. The researches of von den Steinen, Adam, Ehrenreich, and others have settled this beyond reasonable doubt. All the inhabitants of Cuba were Arawacks, but had come from the south. Not a trace of either Carib or Arawack dialects occurs in North America, but they can be found southward to the Rio de la Plata.

Civilization as Influenced by Race.

The perspicuous writer, M. Gustave Le Bon, has an interesting article in the *Revue Scientifique* for October, on the evolution of civilization and the arts as influenced by race. His thesis is that what we call civilization is the expression of certain modes of thought and feeling peculiar to each race; that one race can never thoroughly assimilate the civilization of another; and that the evolution of culture never follows parallel lines in the different races, one developing one element, another diverse elements. This is especially true of arts and religions, these bearing in their evolution little proportion to the remaining moments of culture. A lower race, he maintains, cannot derive much of real utility to itself from another of considerably higher civilization; and, in general, whatever a race thus borrows, it transforms to suit its own individuality and racial psychology, so that little of the original is left.

These opinions he supports by an examination of the traits of the world religions in different races. Islam in India is no longer monotheistic, but as polytheistic as Brahmanism; so is Christianity among Indo-Germanic peoples; marabouts, saints, virgins, and incarnations of deity are worshipped, not at all the one God of the original Semitic cult. In a similar manner government, institutions, and arts are sure to be transformed by the racial mind, acting unconsciously, and adapted to its peculiarities. He concludes that the effort to force European civilization upon the lower races, unless in a much modified form, is vain and hopeless.

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ORIGIN OF VOLITION IN CHILDHOOD.[1]

BY J. MARK BALDWIN.

IN earlier articles of this series[2] I have endeavored to trace the development of the child's active life up to the rise of volition. The transition from the involuntary class of muscular reactions to which the general word "suggestion" applies, to the performance of actions foreseen and intended occurs, as I have before intimated, through the persistence and repetition of imitative suggestions. The distinction between simple imitation and persistent imitation has already been made and illustrated in an earlier article. Now, in saying that volition—the conscious phenomenon of will — arises historically on the basis of persistent imitation, what I mean is this: that *the child's first exhibition of will is its repeated effort to imitate movements seen and noises heard.*

An adequate analysis of will with reference to the fiat of volition reveals three great factors for which a theory of the origin of this function must provide. These three elements of the voluntary process are desire, deliberation, and effort. Desire is distinguished from impulse by its intellectual quality, i. e., the fact that it always has reference to a presentation or pictured object. Organic impulses may pass into desires, when their objects become conscious. Further, desire implies lack of satisfaction of the impulse on which it rests — a degree of inhibition, thwarting, unfulfilment. Put more generally, these two characteristics of desire are: (1) a pictured object suggesting a satisfaction which it does not give, and (2) an incipient motor reaction which the imaged object stimulates but does not discharge.[3]

The first clear cases of desire — as thus understood — in the life of the child are seen in the movements of its hands in grasping after objects seen. As soon as there is clear visual presentation of objects we find impulsive muscular reactions directed toward them, at first in an excessively crude fashion, but becoming rapidly refined. These movements are free and uninhibited — simple sensori-motor suggestive reactions. But I find, in experiments with my children, that the vain grasping at distant objects, which prevailed up to about the sixth month, tended to disappear rapidly in the two subsequent months — just about the time of the rise of imitation. During the eighth month, my child, H., would not grasp at highly-colored objects more than sixteen inches distant, her reaching distance being ten to twelve inches.[4] This training of impulse is evidently an association of muscular (arm) sensations with visual experiences of distance. The suggested reaction becomes inhibited in a growing degree by a counteracting nervous process; and here are the conditions necessary to the rise of desire. It is safe, therefore, I think, to say, that *desire takes its rise in visual suggestion and develops under its lead.*

The two further requisites to the process of volition are deliberation and effort. The word "deliberation" characterizes the content of consciousness, and may be best described as a state of polyideism, or relatively unreduced plurality of presentations, with a corresponding plurality of motor tendencies (motives). The feeling of effort seems to accompany the passage of consciousness into a monoideistic state after deliberation. It arises just when an end is put to the motor plurality by synthesis or co-ordination. Deliberation may exist without effort, as is seen in deliberative suggestion already described and in pathological *aboulia*, in which a man is a prey to un-coordinated impulses.

Now these further conditions of the rise of will are present first in childhood in persistent imitation, the try-try-again experience. In the pre-imitative period, the so-called efforts of infants are suggestive reflexes. My child, E., strained to lift her head in the second month when any one entered the room; and in her fourth month, after being lifted by the clasping of both her hands around her mother's fingers, the mere sight of fingers extended before her made her grasp at them and attempt to raise herself. Such cases — on which many writers rely, e.g., Preyer—fall easily under sensori-motor suggestion as it borders on physiological habit. The nearest it comes to will is that it may involve faint glimmerings of desire, but it certainly lacks all deliberation. Further, simple imitation, as has already been said, can be readily accounted for without any appeal to deliberation or effort and even without an appeal to desire.

In persistent imitation we have an advance on simple imitation in two ways: (1) A comparison of the first result produced by the child (movement, sound) with the suggesting image or "copy" imitated, i. e., deliberation. This gives rise to the state of dissatisfaction, motor restlessness, which is desire, best described as "will-stimulus;" (2) the outburst of this complex motor condition in a new reaction, accompanied in consciousness by the attainment of a monoideistic state (end) and the feeling of effort. Here, then, in persistent imitation we have, thus briefly put, the necessary elements of the voluntary psychosis for the first time present.

The reason that in imitation the material for will is found is seen to be that here the "circular process" already described maintains itself. In reactions which are not imitative (for example, an ordinary pain-movement reaction) this circular process, whereby the result of the first movement becomes itself a stimulus to the second, etc., is not brought about; or, if it do arise, it consists simply in a repetition of the same motor event fixed by association — as the repetition of the *ma* sound so common with very young infants. Consciousness remains monoideistic. But in imitation the reaction performed comes in by eye or ear as a new and different stimulus; here is the state of motor polyideism necessary for the supervention of the feeling of effort.

From this and other lines of evidence,[5] we are able to see more clearly the conditions under which effort arises. It seems clear that (1) the muscular sensations arising from a suggestive reaction do not present all the conditions; in young children, just as in habitual adult performances, muscular sensations simply give a repetition of the muscular event. The kinæsthetic centre empties into a lower motor centre in some such way as that described by James (*Psychology*, II., p. 582) along the diagonal line *mc*, *mp* in

[1] The theory of the rise of volition here announced was presented in detail at the International Congress for Experimental Psychology which met in London in August; a full abstract is to be found in the Proceedings of the Congress. The entire paper with further elaboration is to appear in an early issue of *Brain* (London).

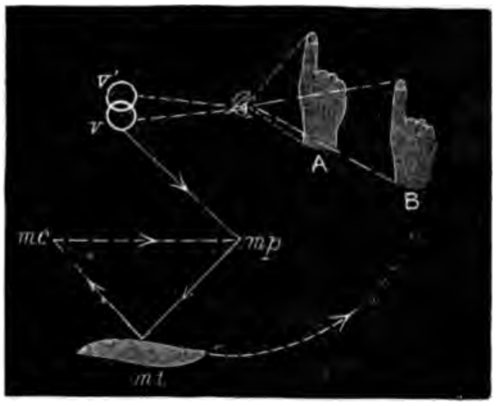
[2] "Suggestion in Infancy," *Science*, Feb. 27, 1891; "Infants' Movements," *Science*, Jan. 8, 1892.

[3] Cf. my "Handbook of Psychology," Vol. II., Chap. XIV., § 2, for a fuller development.

[4] See *Science*, XVI., 1890, p. 247.

[5] Other evidence is (*a*) a research on students, called "Persistent Imitation Experiment," and (*b*) evidence from the pathology of speech; for both of which see the detailed article to appear in *Brain*.

the "motor square" diagram given below (Fig. 1). This is also true when (2) sensations of the "remote" kinæsthetic order (the sight or hearing of movements made) are added to the muscular sensations. They may all coalesce to produce again a repetition of the original reaction. The "remote" and "immediate" sources of motor stimulation reinforce each other. This is seen in a child's satisfied repetition of its own mistakes in speaking and drawing, where it hears and sees its own performances. Con-



IG. I.—*Simple Imitation.* v, v' = visual seat; mp = motor seat; mt = muscle moved; mc = muscle-sense seat; A = "copy" imitated; B = imitation made. The two processes v and v' coalesce and the reaction is repeated without change or effort.

sequently (3) there is muscular effort only when the "copy" persists and is compared with the result of the first reaction; that is, on the physical side, when the two processes started by the "copy" and the reactive result reach the higher co-ordinating centre together. The stimulus to repeated effort arises from the lack of co-ordination or identity in the different stimulations which reach the centre of co-ordination simultaneously. The mental outcome, effort, accompanies the motor outburst of these combined in-

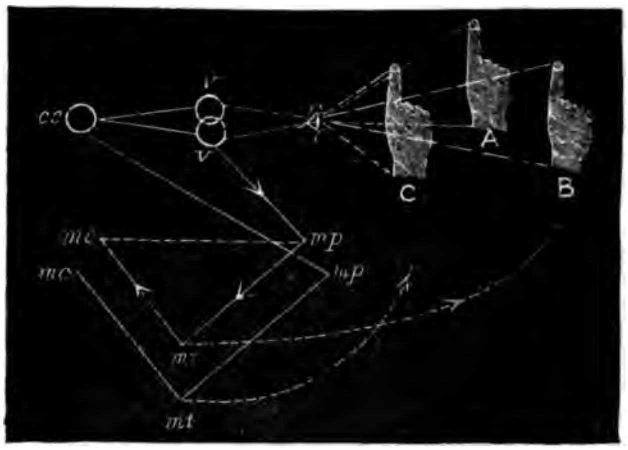


FIG. II.—*Persistent Imitation with Effort.* C=successful imitation; cc=co-ordinating center. (Other letters same as in Fig. I.) The processes at v and v' do not coalesce but are co-ordinated at cc in a new reaction mp', mt', which includes all the elements of the "copy" (A) and more. The useless elements then fall away because they are useless and the successful effort is established.

fluences, and, as soon as this outburst reproduces the "copy," the effort is said to "succeed," the subject is satisfied, "will-stimulus" disappears, and the reaction tends to become simple as habit.

Physiologically the point which distinguishes persistent imitation with effort from simple imitation with repetition is this conflict of processes in the centre. In simple imitation the excitement aroused by the reaction, as its result is reported inwards by the eye or ear, finds no outlet except that already utilized in the first discharge; hence it passes off in the way of a repetition of this discharge. See Fig. 1.

In persistent imitation the first reaction is not repeated. Hence we must suppose the development, in a new centre, of a function of co-ordination by which the two regions excited respectively by the original suggestion and the reported reaction coalesce in a common more voluminous and intense stimulation of the motor centre. A movement is thus produced which, by reason of its greater mass and diffusion, includes more of the elements of the "copy." This is again reported by eye or ear, giving a "remote" excitement, which is again co-ordinated with the original stimulation and with the after effects of the earlier imitations. The result is yet another motor stimulation, or effort, of still greater mass and diffusion, which includes yet more elements of the "copy." And so on, until simply by its increased mass — by the greater range and variety of the motor elements enervated — the "copy" is completely reproduced. The effort thus succeeds. See Fig. 2.

When muscular effort thus succeeds by the simple fact of increased mass and diffusion of reaction, the useless elements fall away because they have no emphasis. The desired motor elements are reinforced by their agreement with the "copy," by the dwelling of attention upon them, by the pleasure which accompanies success. In short, the law of survival of the fittest by natural, or, in this case, physiological, selection assures the persistence of the reaction thus gained by effort.

This theory of the physical process underlying volition is not open to the objections commonly urged against earlier views. How can we conceive the relation of mind and body? The alternatives heretofore current are three: either the mind interferes with brain processes, or it directs brain processes, or it does nothing — these are the three. Now, on the view here presented, none of these is true. The function of the mind is simply to have a persistent presentation — a suggestion, a "copy." The law of sensori-motor reaction does the rest. The muscles reflect the influence of the central excitement; this creates more excitement, which the muscles again reflect; and so on until, by the law of lavish outlay, which nature so often employs, the requisite muscular combination is secured[1] and persists.

Further, a direct examination of the infant's earliest voluntary movements shows the growth in mass, diffusion, and lack of precision which this theory requires. In writing, the young child uses hand, then hand and arm, then hand, arm, tongue, face, and finally his whole body. In speaking, also, he "mouths" his sounds, screws his tongue and hands, etc. And he only gets his movements reduced to order after they have become by effort massive and diffuse. I find no support whatever, in the children themselves, for the current view of psychologists, i.e., that voluntary combinations are gradually built up by adding muscle to muscle and group to group. This is true only after each of these elements has itself become voluntary. Such a view implies that the infant at this stage knows that he uses his muscles, which is false; knows which muscles he has learned to use, which is also false; and is able to avail himself of muscles which he has not learned to use, which is equally false — not to allude to the fact that it leaves suspended in mid-air the problem as to how the new combination intended gets itself realized in the muscles.

It is evident, also, that in accounting for the earliest voluntary movements as cases of persistent imitative suggestion, we are making the presentation which constitutes the "copy" a thing imported into consciousness, a "suggested" thing which is imposed upon the infant by the necessities of its receptive nature. And so it is. Whether and how the mind ever gets away from this chain of suggestions or "copies," selects its own "copy" or end, and secures by its own choice the persistence of it — this is the question of voluntary attention. Its consideration would lead us too far afield from our present topic, the babies.

[1] This application of the principle of "natural selection" to muscular movement is so simple a solution of this crucial problem that I fear I must have overlooked some suggestion of it in the literature of the subject. At any rate, the tracing of it in the phenomena of imitative suggestion has not occurred elsewhere. As a general hypothesis, however, it is independent of the question as to whether muscular effort is first found in imitation.

THE INTERNATIONAL CONGRESS OF EXPERIMENTAL PSYCHOLOGY, HELD IN LONDON, AUGUST, 1892.

BY ARTHUR MACDONALD, SPECIALIST IN THE U. S. BUREAU OF EDUCATION, AND OFFICIAL DELEGATE TO THE CONGRESS.

ONE of the distinguishing features of the late International Congress for Psychology is the prominent part that physiological investigations assumed. This may be taken as an indication of the prevalent tendency to study the objective rather than the subjective side of consciousness. Yet not a few of the members read papers, which gave the results of an empirical study of subjective reality. The subject of hypnotism and allied states was also one of great interest to all.

Some of the most important questions considered were in the domain of the physiology of the brain, about which comparatively little is known. The statement has often been made that the frontal convolutions are the seat of the intellect as distinguished from the will and desire. This was based upon comparison in the development of this region in man and the lower animals, upon results of accident or disease in man and experiments upon monkeys by Ferrier, Horsley, and Schäfer, and upon dogs by Hitzig and Goltz. For the reason that antiseptic precautions were not taken in either Ferrier's earlier experiments or Goltz's or Hitzig's, it is not certain but that the results obtained may have been due to an extension of the effects of the injury. Professor Schäfer thought it worth while to repeat these experiments upon the prefrontal region by a mode of operation that entirely avoided the shock following from a bilateral removal of a more or less extensive part of the brain. He said that he had often noticed in operating upon the brain that extensive bilateral lesions are liable to be followed by apathy and apparent idiocy, whether the operations were in the frontal or in other regions, more in fact in the temporal than in the frontal region. He thinks it is very probable, therefore, that (1) the question of shock and (2) that of considerable loss of brain substance and removal of support from the rest of the brain (thus impairing the cerebral functions generally) may modify the result. For these reasons Professor Schäfer has recently operated, not by actually removing the portions of the brain, but by severing their connections with the rest of the mantle and with the brain-stem. This can be effected with scarcely any hemorrhage and with no perceptible shock. In several instances in which Professor Schäfer has thus severed the prefrontal lobes in monkeys, there was an entire want of appreciable symptoms. In no case did the animals show the dullness and apathy previously noticed, but they appeared as bright and intelligent after recovering from the effects of the anæsthetic as before the operation. These experiments, therefore, do not support the view that the prefrontal lobes are especially the seat of intelligent attention.

In this connection it will be interesting to note Professor Horsley's demonstration of localization of functions in the monkey's brain, which was given before a number of specialists and psycho-physicists. The monkey was put under the influence of an anæsthetic, and quite a portion of the cranium removed. By electric stimulation Professor Horsley demonstrated clearly the fact of localization; he was able to predict before applying the electrodes what movements would take place, as in the arm, fingers, and face. The experiment was very satisfactory to the witnesses, although Professor Horsley did not think it had succeeded as well as in many former cases when he had performed it before his classes. These now well-known localized areas in the brain of monkeys have been found also by Horsley and Schäfer in the anthropoid ape, which is still nearer man. But the proof has been made complete in a demonstration upon human beings by Professor Horsley. It was in the case of two epileptics in whom an operation was necessary. As far as the operation permitted, it was found that the same localization of function existed in man. It is well to note that the success of experiments upon animals is often due to developed operative skill, as is obtained in surgery. The writer has witnessed many operations of this nature by well-known specialists, but has never seen it so neatly done as by Professor Horsley. Professor Horsley was also very careful to see that the animal felt no pain throughout the whole operation. One is reminded of Professor Munk's experiments on the dog at Berlin, which attracted great attention at the time. Both Munk and Horsley are surgeons.

It is true that, if one single function is localized, brain localization is established; but this *a priori* method is being made less and less necessary by experimentation. It would seem from these and other investigations that the intellectual function is diffused over the whole brain; this is strengthened by purely psychological considerations from the directing power of the reasoning faculty over the psychical functions in general. It would seem probable that by more exact methods and skilful operations general localized areas will be established throughout the brain, but that these areas can be absolutely defined is quite improbable; first, because they seem gradually to overreach, one area into the other, and, second, the brain is a vicarious organ and the extent of this characteristic will be difficult to determine. But when one thinks of the complexity of the finer anatomy of the brain, not to mention its histo-physiology and chemism, the vastness of the field of investigation is evident; yet these positive results in the coarser anatomy and physiology are an initial starting-point of the highest importance, and may lead in the future to things as yet unthought of.

A recent experiment illustrating kinæsthesis was described by Dr. Ransom; it was a case of epilepsy where the convulsions began by tingling and spasm in the left hand; the following permanent abnormal conditions resulted in this hand: (1) Slight tactile anæsthesia, (2) diminution of muscular sense, (3) diminution of motor power. The operation showed a cyst compressing the cortical centre for the left hand. After recovery from the operation this area was faradized by electrodes inserted through the scalp, without an anæsthetic. From this resulted (1) contraction of groups of muscles in arm and hand by moderate current, (2) production of sensation with a weaker current, contraction added when current was strengthened, (3) improvement of muscular sense during and after stimulation, (4) weakening of voluntary motor power, after a strongly induced contraction.

Dr. H. Donaldson, in his observations on the anatomy of the brain of Laura Bridgman, found the following peculiarities: depression of the moter speech-centre, a slenderness of the first temporal gyrus on both sides and a blunting of both occipital poles with a special disturbance of the fissures in the right cuneus, poor development of temporal lobes, the cranial nerves connected with the defective sense organs were slender, the left optic nerve being the one most affected; the extent of cortex was normal but unduly thin all over; this thinness, however, was most marked in the areas for the defective senses, due in part at least to the smallness of the cortical cells there present. In general, the case represents a maximum peripheral disturbance in the sensory cranial nerves, associated with only such central lesions as followed from lack of exercise and growth.

In his investigations of the muscular sense in the blind, Dr. Goldscheider found a developed sense of touch in the hand and finger joints, and the cause of this was psychical, consisting in a sharpening of the attention and in practice. The sense of location in the skin is small in the blind. In order to recognize forms by touch, the sensation of motion is of greater importance than the sensibility of the skin. Children, whether blind or not, possess a finer sensibility for passive motion than adults.

An interesting paper was that on "A Law of Perception," by Professor Lange of Odessa. The process of every perception consists in a rapid change of a whole series of psychical moments or steps, in which every preceding step presents a less concrete and more general condition, and every following step a more concrete and differentiated psychical condition. There are four principal steps, or stages, in this process of perception: (1) the simple shock, without quality, (2) the consciousness of general modality in the sensibility, (3) consciousness of its specific quality, and (4) consciousness of its spacial form.

The steps, or stages, of our perception correspond to the development of perception in general biological evolution. The so-called muscular reactian consists in a reaction in consciousness upon a simple and undifferentiated shock; the muscular or the in-

nervation effort is not essential to the muscular reaction. The so-called sensorial reaction is not a determinate act, but the reaction upon one of the following steps of perception. The relation between subject and predicate in an act of judgment is a particular case of the law of perception. The consciousness of difference has no ground in the sense of time. The so-called time of choosing shows no element of will.

Mrs. C. L. Franklin, after explaining the difficulties of the Hering or the Young-Helmholtz theories of light sensations, proposed the following new theory: In its earliest stage of development vision consisted of nothing but a sensation of gray (using the word gray to cover the whole series, black—gray—white). This sensation of gray was brought about by the action upon the nerve-ends of a certain chemical substance, set free in the retina under the influence of light. In the development of the visual sense, the molecule to be decomposed became so differentiated as to lose only a part of its exciting substance at once; these chemical constituents of the exciter of the gray sensation can therefore be present separately and cause the sensation of red, green, and blue. A recombination of these substances produces the gray sensation; the mixing of these three colors gives a sensation of no color at all, but only gray. The theory is that of a differentiated color-molecule.

Professor Pierre Janet gave a somewhat extensive description of a disease which he designates as a new form of psychological disaggregation, a mental disease consisting in the weakening of the power of synthesis, which permits during each moment to attach new psychological phenomena to the personality, which are reproduced in the mind. This disease has different forms, according as the incapacity for synthesis affects the sensations, movements, or souvenirs.

Professor Liégeois of Nancy showed it to be quite probable that a woman, who had been condemned to twenty years of hard labor for attempting to poison her husband, was suggestible and hypnotizable to a high degree; that she had received suggestions from a doctor, her lover, to poison her husband in order to be able to marry the doctor; that her moral liberty was greatly diminished if not abolished. Professor Liégeois commended such cases to magistrates, judges, physicians, and juries, so that incompetence and contradictions and excessive severity may be prevented.

Dr. Liébeault and Professor Liégeois described a case of monomaniacal suicide, which was cured by suggestion during hypnotic sleep. It was a woman who had had tendencies to suicide for eleven months.

Dr. Bérillon, editor of the *Revue de l'Hypnotisme*, spoke on the applications of hypnotic suggestion to education. From an experience of attempting hypnotism with some 250 children of both sexes, he deduced these conclusions: In ten children from six to fifteen, of different classes of society, eight could be put into profound sleep after the first or second seance. Contrary to the general opinion, the difficulties of causing profound sleep were greater in proportion as the child presented neuropathic hereditary defects. Healthy children with good antecedents were generally very suggestible, and consequently hypnotizable; they are very sensitive to imitation. While their sleep has the appearance of normal sleep, yet it is easy to obtain amnesia on awaking, negative hallucinations, suggested dreams, and automatic accomplishment of suggested acts. This sensibility to suggestion and hypnotism has been utilized in treating cases which concern pedagogics as much as medicine; such are those with nervous insomnia, nocturnal terrors, somnambulism, cleptomania, onanism, incontinence of urine, inveterate laziness, filthiness, and moral perversity. These facts have been verified by a large number of authors; they belong to practical psychology. Suggestion constitutes a process of investigation which permits us to submit to a rigorous analysis the different intellectual faculties of children, and thus to aid pedagogics by the experimental method.

Mr. F. W. H. Myers, in a paper on "The Experimental Induction of Hallucinations," considers it a drawback to experimental as compared with introspective psychology that we are liable to lose in profundity what we gain in precision; new experiments are required if the operations of the subconscious strata of our intelligence are to be reached; such operations tend to be manifested spontaneously in forms of active and passive automatism, such as automatic writing and visual or auditory hallucinations. As to the extent to which these phenomena can be reproduced experimentally, hypnotism is at present the principal means. A form of hallucination which is harmless and easily controlled is "crystal vision," that is, the induction of hallucinatory images by looking steadily into a crystal or other clear depth or at a polished surface. In this way the crystal helps the externalization of those images, sometimes by scattered reflections which suggest *points de repère;* or by partially hypnotizing the gazer. But a crystal vision may sometimes pass insensibly into the summoning up of externalized images, or quasi-percepts, with no definite nidus or background. Such images, or percepts, may depend upon a perceptivity antecedent to sensory specialization and of wider scope.

In speaking of experiments in thought-transference, Mrs. Sidgwick considered the hypnotic state as favorable in such inquiries. By thought-transference is meant the communication of ideas from one person whom we call the agent to another called the percipient, independent of the recognized channels of sense. Mrs. Sidgwick conducted her experiments in conjunction with Professor Sidgwick and others. The successful percipients were seven in number, and were generally hypnotized. It was possible to transfer numbers, mental pictures — that is, mental pictures in the agent's mind — and induced hallucinations given by verbal suggestion to one hypnotic subject and transferred by him to another. There were failures, but the proportion of successes was sufficient to show that the result was not due to chance. One percipient succeeded in experiments with numbers, when separated from the agent by a closed door and at a distance of about seventeen feet. Sometimes the ideas reached the percipient as visual impressions received with closed eyes, sometimes as hallucinations on a card or paper, or by automatic writing, or by table tilting.

It is not known how to produce results at will; only certain persons seem capable of acting as agents or percipients, and these persons succeed at one time and fail another, varying at different times in the same day; the reason for this is as yet unknown.

In the nerve-centres of flying in certain insects, Alfred Binet showed that the dorsal root is motor and the ventral root is sensitive.

Professor Preyer of Berlin read a paper on the origin of number. All concepts can arise through the senses only. No concept (even the concept of number) through heredity alone, without individual sense-impressions, can take place. But the child, like many animals, can value things and numbers without knowledge of numbers; it feels the numbers, not by means of touch or sight, but through hearing. The series of positive whole numbers did not arise originally through addition of 1 to 1; such a hypothesis presupposes a knowledge of a number, namely of 2, and a method of adding. Numbers are acquired in a normal way through hearing and comparison of tones, but later through touch and sight.

As to the effect of natural selection on the development of music, Dr. Wallaschek said that primitive music is not an abstract art, but, taken in connection with dance and pantomime, is bound up with the necessities of primitive tribal life, that is, in war and hunting, for which these dances seem to prepare, and, further, that it helps the tribe to maintain its strength and skill during times of peace. These dances are of a social nature, being performed by the whole tribe with great exactness, due to the influence of rhythm, of which primitive music chiefly consists. This tie of music enables the community to act as one body, holding the community together. Tribes accustomed to *play* at war and hunting associate more easily, act better in case of need, and so are better prepared for life. The musical faculty is thus developed and trained for this purpose.

Dr. Witmer presented a contribution to experimental æsthetic, taking up "the æsthetical value of the mathematical proportions of simple figures." No measurements of the proportions of the human form, as found in nature or in art, nor in beautiful specimens of architecture will demonstrate the æsthetic value of the

mathematical relations of their parts; for we never can be sure that their æsthetic value does not rest upon an associative or other factor rather than upon the direct mathematical proportions; and the freedom in the choice of parts to be measured must throw considerable doubt upon the results of all measurements. Such attempts have proved no more than a limited æsthetic value of the proportion 1:1, while for the various other simple mathematical relations nothing decisive has been shown. A better method than Zeising's or Fechner's affords a choice not limited to a set of arbitrary proportions, but opens to a series of figures whose mathematical proportions vary in a constant ratio between the proportion of 1:1 and $1:x$ (x being any desired large number). This method permits of an easy observation of the relative increase or decrease in the æsthetic feeling attaching to the regularly increasing proportions. For all groups of figures and for all positions of the figure there are but two pleasing proportions: the ratio 1:1, or perfect symmetry, and a ratio which lies between 2:3 and 1:2, the most pleasing proportion. The proportion 1:1 is æsthetically so far fron all other proportions that a comparison between it and any other proportion on the same terms as between the other proportions among themselves is impossible. The most pleasing æsthetic proportion subsumes itself under æsthetic contrast; the æsthetic value does not lie in a pleasing and complex equality of the relations of the parts of a figure, but in a pleasing *difference* of parts. The proportion is therefore not clearly discoverable in complex designs and objects, as the demand for the best contrast of parts may easily give way to other considerations.

Dr. Alexander Bain's paper was entitled "The Respective Spheres and Mutual Helps of Introspection and Psycho-Physical Experiment in Psychology;" the recognized sources of our knowledge of mind are first and foremost *introspection* with the aids of outward signs; to which succeed the study of infancy, of abnormal and exceptional minds, and of the lower animals; also the workings of society collectively; next physiology; and last psychophysical experiments. The metaphysical problem of knowing and being, and that of the tracing of the origins of our mental furniture, have hitherto been the leading ones where introspection has been mainly employed. Neither of these are utile in the ordinary sense. Introspection takes the lead in qualitative analysis of mental facts; the next consideration is quantitative analysis, or the mensuration of psychological quantities; here psychophysics can render important service. The following is a list of researches where both methods concur: (1) The economy of muscular mechanism; (2) the fundamental laws of the intellect, more especially as regards memory acquisitions; (3) the fluctuation of our ideas in consciousness; (4) the conditions of permanent association as against "cram;" (5) plurality of simultaneous impressions in all the senses; (6) the fixed idea; (7) similarity in diversity. In all these experiment can come in aid of introspection, but cannot supersede it without loss and failure.

Professor Theodore Ribot's paper concerning concepts had for its object an inquiry as to the immediate state of mind at the instant a concept is thought, to determine whether this state differs in individuals. One hundred persons of every class and degree of culture were interrogated by announcing to them abstract terms (not letting them know the purpose beforehand) and noting the immediate state of consciousness which these terms evoked. The results were: 1. With the majority a general term awakened a concrete idea or representation, ordinarily a visual image, rarely a muscular image. 2. Many saw the word as printed, purely and simply, without any concrete representation. 3. Others (fewer in number) had only the word in the mind as heard, perhaps with motor images of articulation but without concrete image; without vision of the printed word. 4. The highest concepts, such as cause, relation, infinite, etc., did not give rise to any representation whatever in the case of the majority. Even those persons belonging to the pure concrete type declared they had nothing in their mind. There are therefore certain concepts to which an *unconscious* state corresponds. Hoping to penetrate into the nature of this unconscious state, Dr. Wizel continued the investigations on certain hysterical cases at Salpêtrière; they were interrogated first in the hypnotic state, then when awake, thus permitting a comparison of responses. The results were more numerous and explicit in the hypnotic state than in the normal.

In speaking of the future of psychology, Richet said that psychology is one of the elements of physiology, and the most obscure; the first question is to know the connection which unites mind and body; at present we know nothing about it. An idea, a reasoning, a passion, are phenomena which do not seem to have the power of being reduced to a material phenomenon. It is certain, however, that there is a connection: without brain, or rather without nerve-cell, there is no intelligence. The first problem of psychology is therefore a most complete physiology of the brain: relations of ideation with cerebral circulation, with chemical changes in nerve-cells, with electric phenomena; localization of psychical acts in this or that part of the brain; in other words, a physiological *résumé* of the brain. We must recognize that brain physiology is little developed compared with the physiology of the heart or muscles. Physiology, properly speaking, is a study of sensations: relations of sensation with peripheral excitation, differential perceptive sensibility — the threshold of excitation; these are investigations more difficult to pursue than the general physiology of the nerve-cell.

Comparative psychology treats of the relations of man with other beings, and with the insane and criminal, from the intellectual point of view. One cannot admit that the human soul is stationary; it evolves, and therefore can be perfected through a sort of natural selection. The data for this problem are wanting, yet the future of humanity depends upon it. In transcendental psychology we have numerous data (often or almost always imperfect), which permit us to suppose that human intelligence has extraordinary resources and forces of which we have no conception. The future psychology will give us the key to clairvoyance and presentiments. If it should be proved that these are all illusions, a service would be rendered; sooner or later we will be able to say whether transcendental psychology is a reality or an illusion.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Libyan Alphabet.

I SHALL make no reply to the letter of Professor Keane in *Science*, Nov. 4, as there can be no advantage in discussing scientific questions in either the tone or the method which he adopts.

As the general subject, however, is one of great interest, I have secured permission to bring it before the Oriental Club of Philadelphia at its December meeting, when I expect to prove the following positions:

1. That certain able French scholars maintain that the Libyan alphabet antedates the foundation of Carthage, and probably had other than a Semitic origin.

2. That the first form of every letter, simple and compound, of this alphabet, as given by Hanoteau in his "Grammaire Tamachek," contains no curved lines.

3. That the only similarity noted by Hanoteau in that work between the Tuareg and Semitic writing is that they are both read from right to left.

4. Abundant documents in "Tifinar" to prove that this is not the case will be laid before the club.

5. Proof will also be presented that Prof. Keane's assertion in his last letter that "the Tuaregs never made any extensive use of this script" is utterly erroneous.

An official report will be made to *Science* of this meeting. As the president of the club is Mr. Talcott Williams, not only an excellent Arabic scholar, but the only American who, so far as I know, has collected Berber manuscripts in North Africa and brought to this country the only originals we have, readers of *Science* may expect a fairer statement of the case than in a discussion where personal irritation may be suspected of obscuring scientific fact.

D. G. BRINTON.

Philadelphia, Nov. 4

Sense of Direction in Animals.

HAVING noticed the recent articles in *Science* on this subject, I wish to add an item that may be to the point

When living near Neosho Falls, Kansas, a neighbor, who was a market bird-hunter, went from there to western Missouri for the purpose of hunting quails and prairie-chickens in the fall of the year. He took with him a favorite pointer dog. The route taken was southward some fifty miles to Parsons, Kansas, by railroad thence north-eastward to Fort Scott, and on into Missouri nearly due east from the latter point. All went very well for a few days after he began hunting, but by some means the dog became lost from him. He spent two days hunting it, and as it was no use to try to hunt without the dog he went home, and there found the dog all right. According to the report of his family. the dog had reached there within two days from the time he lost him, and, as the distance was more than 75 miles, it is quite certain that the dog took a near cut for home. Now if this dog had no sense of direction, what had he that led him to take what we may confidently believe to be the straight and true course for home when he had passed over the other two sides of the triangle by rail?

Who does not know that a cat, or even a half-grown kitten, taken a long way from home in a bag nearly always finds its way back? When living in northern Michigan I had a cat we were tired of. I took her in a boat directly across the lake about two miles and turned her loose. Although it was about six miles around the end of the lake, a circuitous course, and certainly one unknown to her by sight, the next morning she was back at the old place. Another case is just stated to me of a cat that was taken by rail fully twenty miles in south-west Missouri, and the next day he walked in all right at his former home.

H. E. VAN DEMAN.

Washington, D.C.

A Lamentable Case.

PERHAPS another case like the one here recorded will never appear in your columns. At least we may hope so. The person referred to, and whose name will not be mentioned, from the respect in which I held him, was a true lover of nature and an observer. I first knew him, over a score of years since, when to my boyish view he presented the prime features of a country naturalist's existence. He was a poor man and not well educated, but he was a lover of my pursuits, and he read excellent books.

Long years after, and upon returning from a residence in another quarter, I inquired about my nature-loving friend, and found that he was cared for at the County House. I went to call upon him and found that he was dead. One line in the poor-house register was all I could find concerning the blameless man, for the present proprietor came after he was gone and knew nothing of him. There it was: ——— ———, aged — years, died ———.

In my fancy I compared him to Thoreau, and he undoubtedly had similar thoughts and feelings.

How lov'd, how honour'd once, avails thee not,
To whom related, or by whom begot;
A heap of dust alone remains of thee;
'Tis all thou art, and all the proud shall be!

M. G.

Flight of Archippus.

ON the morning of October 22, between eight and nine o'clock, I witnessed the largest flight of *Danais archippus* I have ever seen, and the only one I have observed in Texas. The morning was cloudy with little or no breeze. The direction of the flight was southward. The butterflies were not in such close masses as I have seen them previously, and were flying at various elevations from twenty feet to as great a height as the eye could reach. I counted one hundred passing a given line in less than one minute. After watching them for some time I drove across the line of flight a quarter, or perhaps one-third, of a mile and then northward with the line of flight for more than a mile. Over the whole distance the butterflies were fully as numerous as when I first saw them.

E. T. DUMBLE.

Austin, Tex., Nov. 1.

Codling-Moth Statistics from Oregon.

THE following points have been determined here this season, and may be of interest to the entomological readers of *Science*. Average life of moth, 10–15 days; egg-laping taking place during the latter part of that time. Time required for incubation, 4–10 days; length of life of larva in apple, 4 weeks (about); time passed in cocoon before emergence of moth, 23 days.

This tallies very closely with Riley's observations made a number of years ago in the East; but he makes the life in the cocoon considerably longer.

The first moths were observed here May 16, and the last egg noted, apparently fresh, on a pear September 19. The moth is at least four-brooded in Oregon.

F. L. WASHBURN.

State Experiment Station, Corvallis, Ore., Oct. 25.

Action of Electric-Light on Plants.

IN various reports of the effects of electric-light upon the growth of plants I have noticed nothing upon the, to me, interesting question of whether the effect of electric-light is to keep open at night flowers like the lily and evening primrose, which ordinarily close at departure of daylight. If this point has been discussed, can you kindly give me reference to such discussion?

C. H. AMES.

Boston, Mass., Nov. 8.

Chemical Nomenclature.

WOULD you kindly correct an error which inadvertently crept into my article on the "Spelling and Pronunciation of Chemical Terms" in the current issue? On page 273, column 1, line 16 from the top, instead of "by an American chemist" read "from a North American mineral."

T. H. NORTON.

Cincinnati, Nov. 12.

The Humming-Bird's Food.

DOCTOR MORRIS GIBBS'S article recalls an observation which suggests that the humming-bird may find, in spring, an important supply of food in the sap of certain trees — particularly before flowers are abundant. In the case observed it was taking the sap of *Quercus rubra*. Other trees would furnish a more agreeable repast, doubtless.

H. L. BRUNER.

BOOK-REVIEWS.

Manners and Monuments of Prehistoric Peoples. By the MARQUIS DE NADAILLAC. Translated by NANCY BELL. Illustrated. 412 p. New York, G. P. Putnam's Sons. $3.

The author of this work is already favorably known in this country by his excellent "Prehistoric America," and in France he ranks among the most active and respected of the students of prehistory. In this volume he endeavors to present a faithful and vivid portraiture of the life of man during the Stone Age, especially in Europe, though by no means confined to that continent. He does not undertake to assign a definite length to this phase of civilization, recognizing that it is not so much a period of duration as a stage in culture. He concedes, however, that it was in ancient Europe of great length, "countless centuries."

During the greater part of it man depended upon hunting, fishing, and the natural products. But even then his arts had begun. He made weapons and tools, he used clothing, pleased himself with ornaments, was acquainted with fire, dug canoes from trees, and at times produced creditable artistic sculptures and drawings. The origin and growth of these arts are illustrated by numerous examples drawn from a surprisingly wide familiarity with the literature of the branch.

An interesting chapter is devoted to the kitchen-middens, caves, pile-dwellings, and stone buildings, which served to protect the ancient natives. He describes the magalithic monuments, such as the dolmens, menhirs, and cromlechs, which have excited so much discussion, but declines to assign them to any known people. Yet if, as he intimates, many of those in France were constructed during the Bronze Age, it is difficult to avoid the conclusion that they were by the peoples whom Cæsar mentions as living there at the time of his conquest of Gaul.

The industry, commerce, and social organization of men in the Stone Age are inferred from a variety of evidence, and form the subject of an interesting chapter. The care which they evidently took of the wounded reflects favorably both on their kindness and skill. A chapter on fortifications concludes with an excellent summary of Dr. Schliemann's investigations on the site of ancient Troy.

In handling such a mass of material a few errors naturally creep in. It is not correct to say (p. 21) that "the mounds of North America contain none but copper implements and ornaments," as ornaments of gold, silver, and meteoric iron are not unfrequent. So (on p. 76) the writer says that the ancient canoes "must have been worked by means of oars," and seems surprised too at the absence of rowlocks. Of course, paddles, not oars, were the means of propulsion. It is difficult to perceive what he means by this extraordinary passage on p. 219 — "The most ancient settlements of Malabar contain iron tridents, and Genesius (*sic*) dates their use from before the deluge. It is, therefore, surprising to find that some races remained for an illimitable time ignorant of the way to procure a metal of such great utility." This sounds like eighteenth century science. But these are slight blemishes on a book of singular merit in its composition and unusually beautifully printed and illustrated.

Alaskana, or Alaska in Descriptive and Legendary Poems. By BUSHROD W. JAMES. 368 p. Illustrated. Philadelphia, Porter & Coates.

IF Professor James had not had the unfortunate idea that he is a poet, he would have written a book of considerable interest, as he has visited various localities in Alaska and has read several works about that country. As it is, he gives us 360 solid pages of verses in the meter of "Hiawatha," with "some slight improvements," as the announcement of the publishers modestly puts it, describing the natives, the scenery, the seals, the sunsets, and the stories, which he has by the above means found out about.

It would be unfair not to supply a sample of his poetry, which we select at random from his canto or fytte on the Alaskan native tribes: —

> The Orarians take precedence,
> Classed as Esquimaux or Innuits,
> Dark Creoles, and sturdy Aleuts —
> These hold close along the sea-board,
> Claiming nearly all the coast-line
> And the islands near adjoining; —
> Save where here and there the Indians
> Have and hold small coast possessions
> Which they won by force or cunning.

Really, was it worth while to put capital letters at the head of these lines? And are there people who will read 360 pages of such? If so, human nature has certain qualities of patience or kindliness for which we did not give it sufficient credit.

There are a number of photogravures in the volume, very nicely done, and, as far as type and paper go, it is a creditable specimen of the publisher's taste, and looks as if it was intended to be a "Holiday book."

Experiments Arranged for Students in General Chemistry. By EDGAR F. SMITH and HARRY F. KELLAR. Philadelphia, T. Blakiston, Son & Co. 8°. 57 p., with alternate leaves blank for notes.

THIS series of exercises, based on the authors' experience with their own classes, is intended to accompany any convenient text-book of inorganic chemistry; but reference is made to that of Richter. Beginning with fundamental operations (as with blow-pipe, glass tubing, balance, and graduates) and general principles (as the difference between chemical and physical change) the course proceeds to the study of hydrogen and other non-metals in Part I., followed by the metals in Part II. Quantitative relations are well presented in the experimental work and stoichiometrical

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Nov. 12.—J. P. Iddings, Geology of the Crazy Mountains; H. W. Turner, Lavas of Mount Ingalls; W. H. Dall, Dates of Publication of Conrad's Monographs of Tertiary Fossils.

Anthropological Society, Washington.

Nov. 15.—Warren K. Moorehead, Xenia, O., Singular Copper Objects from Ancient Mounds in Ohio; James Mooney, Lester F. Ward, W. H. Holmes, W. Hallet Phillips, W. H. Babcock, and Frank Baker, Geographic Nomenclature of the District and Vicinity, a Symposium.

Society of Natural History, Boston.

Nov. 16.—Warren Upham, The Origin of Drumlins; Professors Shaler and Davis, On the Origin of Drumlins.

THE Civil Service Commission will hold examinations on Nov. 29 to fill two vacancies in the Quartermaster-General's Office, one in the position of assistant civil engineer, at a salary of $1,200, the other in the position of architectural draftsman, at a salary of $1,400. An application blank and information as to the subjects of the examination may be obtained of the U. S. Civil Service Commission, Washington, D.C.

problems, as in determining the *H*-equivalent of zinc, the density of *Cl*, eudiometric combustion of methane, etc.

Methods of Gas Analysis. By DR. WALTHER HEMPEL. Macmillan & Co. 399 p. $1.90.

THIS standard work was translated by Professor L. M. Dennis with the personal co-operation of the author. Part I. discusses general methods, including the collection of samples, the use of gas burettes and pipettes, purification of mercury, and absorption apparatus; Part II. deals with special methods for the several elementary and compound gases; while Part III. presents the practical applications of furnace gases, illuminating gas, the sulphuric acid industry, the atmosphere, elementary analysis, and the heating power of fuel. The reputation of the author is guarantee for the value of this new volume to chemists interested in his lines of work.

AMONG THE PUBLISHERS.

A NEW edition of the "New Elementary Algebra," by Charles Davies, LL.D., edited by Professor Van Amringe of Columbia College, has been issued by the American Book Co. This work, it seems unnecessary to say, so well known is it, is designed to supply a connecting-link between arithmetic and algebra, to indicate the unity of the methods, and to conduct the pupil from the arithmetical processes to the more abstract methods of analysis by simple and easy gradations, and to serve as an introduction to more advanced works on the subject. The present edition has incorporated in it such emendations as the progress of educational science has suggested.

— The American Book Company have just published the "Standard Arithmetic," embracing a complete course for schools and academies, by William J. Milne, Ph.D., LL.D., president of the New York State Normal College at Albany. Recognizing the fact that, aside from the general knowledge of arithmetic necessary to all intelligent persons, there are special applications of this branch of mathematics that call for special training on the part of the student, the author has prepared this work with a view to meeting such requirements. Provision is made to furnish ample practice, for instance, for the student who desires merely to become a rapid and accurate accountant, as well as for the one who prefers the training which cultivates the reasoning powers at the expense of practical expertness in the use of numbers. The scope of the work is sufficiently comprehensive to meet the demands of even the most advanced school.

— "Nature Study for the Common Schools" is the title of a neat volume of about 450 pages from the press of Henry Holt & Co. It is the work of Wilbur S. Jackman, A.B., teacher of natural science in the Cook County Normal School, Chicago, and is intended to be a guide for teachers in the common schools, who wish their pupils to pursue an adequate and symmetrical course in natural science. The plan adopted is based upon what the author believes to be the proper interpretation of the character of the knowledge that the average child may be readily induced to acquire. Instead of endeavoring to give the pupil a thorough knowledge of a few animals and plants, an effort is made to give him some knowledge of everything with which he comes into contact; this knowledge, of course, once acquired to serve both as foundation for and incentive to further acquisitions in the same general direction. The volume, it may be well to add, is written for the teacher, not for the pupil.

— At the October meeting of the Agassiz Club at Corvallis, Oregon, a society recently formed for the discussion of scientific subjects, Professor H. T. French exhibited some clover growing in a root-cage, and showing nitrogen nodules on the roots; Professor Craig, some alfalfa infected with dodder, and Professor Washburn, a new insect-breeding cage. The paper of the evening was by Mr. Thomas Jeffreys, and was entitled "What constitutes American citizenship?"

TO THOSE INTERESTED IN SCIENCE.

[Science (weekly) established in 1883, N. D. C. HODGES, 874 Broadway, New York City.]

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Bird on Its Nest, The.
Birds Breeding at Hanover, N. H.
Botanical Laboratory, A.
Botanists, American and Nomenclature.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diamonds in Meteorites.
Diphtheria, Tox-Albumin.
Dynamics, Fundamental Hypotheses of.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
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Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers Association.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, New Method of Protecting Buildings from.
Lion Breeding.
Lissajou's Curves, Apparatus for the Production of.
Maize Plant, Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
Patent Office Building, The.
Physa Heterostropha Say, Notes on the Fertility of.
Pict's House, A.
Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
Psychological Laboratory at Toronto.
Psychological Training, The Need of.
Psylla, the Pear-Tree.
Rain-Making.
Rice-Culture in Japan, Mexico and the United States.
Rivers, Evolution of the Loup, in Nebraska.
Scientific Alliance, The.
Sistrurus and Crotalophorus.
Star Photography, Notes on.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Weeds, American.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

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SCIENCE

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MODERN QUARRY REFUSE AND THE PALÆOLITHIC THEORY.

BY W. H. HOLMES.

ONE of the most important industries engaged in by the American aborigines in pre-Columbian and largely also in post-Columbian times was the search for and acquirement of the raw material for making implements and utensils of stone. Quarrying and mining were carried on in many places upon a vast scale, and in one case at least the work has been prosecuted without interruption down to the present time. The operations were, in most cases, carried on in remote or out of the way places, so that the sites remained for a long time undiscovered, and the industry and its accompanying arts have to a great extent escaped the attention of archæologists. This work is now undergoing thorough investigation, and will henceforth take its place among the most important achievements of the native races, a work claiming precedence over nearly all others, lying as it does at the very threshold of art and constituting the foundations upon which the superstructure of human culture is built. Within the limits of the United States flint, chert, novaculite, quartz, quartzite, slate, argillite, jasper, pipestone, steatite, mica, and copper were most extensively sought.

The work in the quarries producing flakable varieties of stone was confined almost exclusively to obtaining and testing the raw material and to roughing out the tools and utensils to be made. The quarrying was accomplished mainly by the aid of stone, wood, and bone utensils, aided in some cases, perhaps, by fire. With these simple means the solid beds of rock were penetrated to depths often reaching twenty-five feet, and extensive areas were worked over, changing the appearance of valleys and remodeling hills and mountains. The extent of this work is in several cases so vast as to fill the beholder with astonishment. In one place in Arkansas it is estimated that upwards of 100,000 cubic yards of stone have been removed and worked over. The most notable features of these remarkable quarry sites are the innumerable pits and trenches and the heaps and ridges of excavated *débris* and refuse of manufacture surrounding them.

Many of the excavations have a new look, as if deserted but recently, whilst others are almost wholly obliterated as if by age. It is essential to observe, however, that where pits are sunk in solid rock and upon convex surfaces they fill very slowly, and that those in friable materials and upon slopes or concave surfaces fill rapidly. The oldest appearing may, therefore, be the youngest.

Several great quarries from which the flaked stone implements of the aborigines were derived have been examined. One of the most important is situated in the District of Columbia, two are in Ohio, two occur in Arkansas, one is in Pennsylvania, and another in the Indian Territory. These quarries cover areas varying from a few acres to several square miles in extent. They are pitted and trenched to various depths, and are thickly strewn with the *débris* of manufacture, including countless numbers of partially worked or incipient implements rejected on account of defects of texture and fracture resulting in eccentricities of shape. These rejects are extremely uniform in type in these quarries as well as elsewhere throughout the country, varying little save with variations in the nature and conditions of the raw material, the general result aimed at being always the same. It is therefore inadvisable in this brief sketch to describe the quarries separately or in great detail, as other more important matters must receive attention.

Rudely flaked stones are not confined to the great quarries; the raw material was worked wherever it was found scattered over the surface of the ground. The refuse deposits of village and lodge sites located conveniently to the stone-yielding districts also naturally contain many rejects of manufacture. Beyond these limits — the limits of the raw material — the rude specimens are rarely found. The main difference between the quarry shaping and the shaping done upon isolated shops and village and lodge sites is that upon the former, where the work was carried on extensively and consisted in securing the raw material in convenient form for transportation and trade, no specialization was undertaken, whereas upon ordinary shop and dwelling sites the full range of the roughing-out and finishing operations was sometimes conducted, the implement shaped being carried directly through from beginning to finish. In all cases the operations of shaping were, in the quarries, confined to free-hand percussion, further and more refined shaping being conducted elsewhere and employing the more delicate methods of indirect percussion and pressure.

The hammers used in breaking up the rock and in flaking are very numerous in most of the quarries; 500 examples, varying from 1 to 12 inches in diameter, were picked up in a few days' work in one of the great quarries of Arkansas. These hammers are generally of artificially discoid or globular forms. Such artificial forms of hammers are rare, however, in the bowlder quarries of the east, since bowlders of suitable form could be picked up on all hands and were discarded and fresh ones selected before the outline was perceptibly or seriously modified by use.

The true quarry, or more properly speaking the quarry-shop, product — that is to say, the articles made and carried away — may readily be determined in each case. This is rendered easy by the occurrence in the quarries of specimens broken at all stages of progress from the beginning to the end of the roughing-out process. The final quarry-shop form — and it must be especially noted that there was practically but one form — is naturally something beyond or higher than the most finished form found entire among the refuse. This form is necessarily, however, quite well represented by specimens broken at or near the final stages of the work. A most exhaustive examination of the great quarry sites has shown beyond the shadow of a doubt that this final form was almost exclusively a leaf-shaped blade, represented on the sites most accurately by broken pieces, all the acceptable blades having been carried away. This is the blade, varying in size and outline with the nature of the material and the particular end kept in view by the workmen, so often found in caches or hoardes distributed over the country and occurring in greater or less numbers on nearly every important village site. The place of this blade in the series of progressive stages of the manufacture of flaked tools is readily ascertained by a systematic study of the subject. It is the form through which nearly every common American variety of highly-developed flaked tool must pass before its final specialization is attempted. It is the blank form ready for the finishing shops, tested in the quarry shops for quality of material and availability for further elaboration, and reduced in weight so far, and only so far, as to make transportation easy or profitable.

In most of the quarries a limited number of cores are found, from which small, generally very delicate, flakes were removed for use in the arts, and used, as a rule, apparently without much modification of shape. They were probably hafted for uses in which delicate manipulation was necessary. Their production was not an important feature of the quarry-shop work.

The question, very properly raised, as to what we really know of the nature and destination of the leading quarry-shop product, the blade or blank form, may be answered by asking another

question. Let us inquire whence came the millions of flaked implements of quartz, quartzite, chert, flint, slate, argillite, jasper, and novaculite that cover the hills and valleys of America, that occur upon every fishing-ground, shell bank, refuse heap, and village site occupied by the American aborigines, historic and prehistoric? They did not grow to be picked like ripe fruit from trees, nor could they have been dug up like potatoes from the ground. Where are the quarries and the shops from which the Indian secured his enormous supplies? For every million of spear and arrow points, knives, perforators, and scrapers — and there were many millions used by him — there are somewhere in America many times as many millions of broken and malformed failures of the very kind found in our quarries and shops, and where are they now but in these quarries and shops? The conclusion is inevitable. The finished and the unfinished (or rude) forms complement each other, and constitute a unit in art and in time. It was only our entire lack of knowledge of the subject that made other theories necessary or other conclusions possible.

These determinations with respect to the nature of the great body of the rudely-flaked stones of America may be expected to have some bearing upon the question of the occupation of this continent in glacial times by a people not yet advanced beyond the primal or palæolithic stage of culture, since the theory of that occupation is based upon the discovery of closely analogous objects in the gravels and elsewhere.

Before the refuse of quarrying and manufacture were studied and the true nature of the rudely-flaked forms determined, these objects had been quite extensively collected, and because of their rudeness and their supposed close resemblance to the early forms of European flaked-stone tools, had been classed as palæolithic and were so labelled in many museums, and as such found a place in the archæologic literature of both continents. It is now conceded by scientific men that this is all wrong, and that in the present state of our knowledge the separation of a single specimen from the main body of flaked stone art in America, save upon purely geologic evidence, is wholly unwarranted.

It is manifestly folly to attempt to select from the mass of these objects certain individual specimens to be arbitrarily called palæolithic. The selections made are quite as likely to be the youngest as the oldest. It is a well-established fact that many of the rudest flaked forms known, the simplest possible art shapes, are obtained from the shell-deposits and from the soapstone quarries of the eastern United States, and thus represent the most modern phases of neolithic Indian work in stone. Even if it be conceded for the sake of argument that there are multitudes of true palæolithic objects and implements scattered over the country, it is certain that up to the present date we have established no standards of form-comparison by means of which they can be detected.

Until geologic formations, glacial or otherwise, have furnished demonstrably palæolithic forms in sufficient numbers to warrant the establishment of types of implements peculiar to these formations, surface finds can be of no service whatever to advocates of the palæolithic idea.

The reported discovery of rude forms of implements in the gravels at Trenton, New Jersey, and subsequently at several points in the Mississippi Valley, led to the conclusion that palæolithic man dwelt here in gravel-forming time, and the theory that a well-differentiated period of rude flaked stone art precedes, in the normal order of development, a pecked and polished stone period, found a foothold in this country. Observations have multiplied, and the occurrence of flaked stones in the gravels is now supported by a large body of evidence. If even a small percentage of these observations are authentic, the evidence ought to be considered sufficient to settle *one* of the questions at issue, that of the *age* of occupation; for the finding of a very small number of works of art, either implements, shop rejects, or flakes — in fact, anything artificial — in the gravels by competent and reputable observers of geologic phenomena is all that is required to satisfy the scientific world of the presence of man of some grade of culture, primitive or otherwise, in gravel-forming times. To this conclusion there can be no serious objection. So far as I know, the possibility that there were glacial men, inter-glacial, and post-glacial men somewhere upon the continent is not seriously questioned by any one. The infancy of the race may have been passed upon the eastern continent, but there is no sufficient reason why America may not have had a share in the nursing.

As I am not prepared to challenge the testimony brought forward by various collectors tending to establish the glacial age of human occupation, defective as much of that testimony seems to be, I will not raise the question of age, but proceed to consider the bearing of the evidence furnished by the quarry shops upon the question of the *grade* of culture indicated by the so-called gravel finds; the *age*, or period, of the occupation and the grade of culture attained being two very distinct things. Admitting for present convenience, then, that men dwelt in America in glacial times, I take up the question as to whether the culture of the hypothetic people, as indicated by the evidence furnished, is surely palæolithic. It has been repeatedly stated, and is still believed by many, that the gravel finds of the eastern United States closely resemble well-established European types of palæolithic implements. The critical observer will find, however, that this resemblance is superficial, and that they have a very much closer analogy with the rude quarry-shop rejects of America; and the latter are not really implements, and should not be called such any more than the faulty blocks of marble left in and about the quarries at Carrara should be classed as statuary. The distinctive feature of European palæolithic implements is, or ought to be, their evidence of specialization of form, their adaptation to definite use, indicated by what is known as secondary flaking; whereas these objects from the American gravels, with rare exceptions indeed, exhibit a total lack of this character. The semblance of specialization in thousands of the rude quarry rejects which have been worked hardly more than to test the flakability of the stone, not having begun to assume the contour and appearance of the implement contemplated by the workman, is more pronounced than in any of these gravel specimens. Appearance of specialization of form, may, therefore, signify nothing, and, if found, must not be taken alone as sufficient evidence that the object having it is a *bona fide* implement.

It should be further noted that not only are the gravel finds identical in form and material with the ordinary failures of the modern aborigines, but that they display the same mastery of shaping operations, beginning in the same way, progressing along the same lines, and ending at the same points, exhibiting no evidence of special adaptation to use in cutting, digging, picking, striking, or any other primitive manipulative act. It is also observed that none of these articles exhibit well-defined evidences of having been used, although it must be conceded that the rudest peoples made their tools for use; and it would appear that, as a rule, if they had been used they would bear very decided indications of that use, and would show a certain amount of specialization as a result of that use. Considering all of these points, I call attention to the extreme probability that these reputed gravel objects are not implements at all, but ordinary failures resulting from the manufacture of more highly specialized forms.

Again, it will be remembered that the gravel finds of the Pacific coast and some of those east of the mountains are neolithic, the forms being of a high grade technically and functionally, so that neolithic man is shown to have probably existed upon the continent whilst the eastern gravels were forming, and the condition of the art phenomena imply that he had dwelt here or somewhere east, west, north, or south, for a very long time, for thousands of years, if not for tens of thousands, and that, too, since he had passed the primal stages of art designated palæolithic.

How then is it to be proved that these particular rude forms, found so sparingly scattered through the gravels at Trenton and elsewhere, really represent and prove a palæolithic age, since they may simply be the rejects of manufacture left upon the banks of the glacial rivers by advanced neolithic men, who dwelt as intelligent men would upon the upper terraces out of reach of the icy floods? The argument that in these gravels rude forms only are found has no value whatsoever, since, as I have shown, it is the rule that where the raw material was sought beyond habitable sites no work save the roughing-out was undertaken, and no flaked forms save rude ones were left upon the ground. Because a few dozen specimens of rudely-flaked stones are found in the

gravels, and no highly specialized forms or other works of art are found with them, the conclusion is reached that they are palæolithic implements and that the art of the gravel-forming time was exclusively rude or palæolithic. Yet we may go down to the Potomac in the District of Columbia, or to the Washita in Arkansas, or to the Neosho in Indian Territory, and gather tons of similar rude forms made by our modern neolithic tribes, without finding a single specialized form or a single object of art aside from these rude forms. It is not my intention, however, to try to reconstruct the culture of that time, as I am not sure that there was any culture, but to point out the total inadequacy of the evidence upon which the theories of a particular culture are based.

The torrent-swept flood-plains of glacial times were hardly habitable places, and we do not know that there was game or fish to be sought there; but the great beds of bowlders then and there accumulating furnished more or less raw material suitable for flaking, and if men, supposing they existed, coming down to the banks of the streams during periods of low water, essayed to rough-out their spear-points and knives in the usual fashion, the ever-recurring torrents would scatter the refuse about, leaving the coarse pieces in one eddy and whirling the lighter ones to other eddies below.

From this and from what has gone before it is clearly seen that these reputed gravel objects are probably not implements at all, and, whether they are or not, that they are as likely to have been left by neolithic as by palæolithic men.

So far have the advocates of a European classification for American phenomena gone beyond the limits of prudence in the treatment of these so called palæolithic stones, that a radical change is demanded in the methods of classifying and labelling these objects in many of our museums; and it is to be lamented that a revision of all literature relating to the subject cannot be made in order to prevent the further spread of errors already too deeply rooted in the minds of the people, without offensive criticism of the work of living students.

This point may be illustrated by one example of the many that could be cited. The quartz objects from Minnesota, usually known as the Babbitt finds, of which so much has been said and written, prove on careful examination to be modern work-shop refuse settled into the talus of the glacial terrace. The slightly worked pieces heretofore collected and published as palæolithic implements almost without question on the part of archæologists as to their origin or manner of occurrence, have no more intimate relation to the history of the glacial terraces than have the trees that grow upon their surface or the rodents that burrow in their sandy soil.

No rude flaked stone should be classified or labelled as an implement until it is proved to be an implement, and no specimen should be called palæolithic simply because it is rude or because it is found in the gravels, howsoever old. The attempt to classify these rude stones and to arrange them under types after the manner of European implements is sufficiently characterized, when it is stated that there is not in the museums of Europe or America a single piece of flaked stone found in place in the gravels of America and satisfactorily verified that can with absolute safety be classified as an implement at all.

If I should find a rude stone in place in the gravels — I have tried long in vain — I should permit myself to say only this, "Here is a work of art dating back to glacial times, I cannot tell whether it is a finished implement or not, as there are but slight signs of specialization and no indications of use, and I cannot tell whether it was made and left by a palæolithic or by a neolithic people, because neither of these peoples had a patent upon rude forms." Even if rude flaked stones are found in gravels ten times as old as the Trenton gravels, it must still be shown that they are not neolithic before it can be safely asserted that they are palæolithic, for the exclusively rude period of flaked art observed in Europe is so extraordinary that its repetition in other countries would approach the marvellous.

Little by little the advocates of a period of palæolithic culture in America have been forced to give up the idea that there is any other reliable test of the age of a culture than that furnished by geology; yet they are still going on utterly failing to recognize the equally important fact that geologic phenomena cannot be safely observed save by geologists, and I may add with respect to gravel phenomena that the observations of geologists are not always infallible, the observations of geologists who have not especially studied gravels being of little greater weight than those of laymen. They must further concede that the finding of rude implements in the gravels or other ancient formations is not proof of a palæolithic age until it is sufficiently proved that the culture represented is exclusively rude culture, a point not attained, and I fear well nigh unattainable.

It follows from the above considerations that all speculations upon the culture status, ethnic relationships and geographic distribution of gravel-man in America based upon the discovery of rude forms of art are premature and misleading, and that, instead of being on firm ground and well advanced in respect to the antiquity and history of early man in America, we are not yet safely on the threshold of the study; and it is patent that until geologists take hold of the problem and prosecute the work, not as a side issue but as a great and leading question germane to the field of geologic research, little true progress will be made.

My explorations have been made with the greatest care and rarely without the aid and advice of some of the foremost geologists and anthropologists of the country. The conclusions reached have been freely discussed, and are generally approved by those familiar with the facts. These conclusions are subject to modification through the acquisition of new evidence derived from actual research in the field and in no other way.

In closing I would add that conservative students of American archæology will find it wise to consider well the following points relating to early man in America. 1. Is there a sufficiently full and sound body of evidence to demonstrate the presence of glacial man in America? 2. Is there satisfactory evidence that glacial man, if his existence be admitted upon the evidence available, was in any particular region in the palæolithic stage of culture? 3. Is there satisfactory evidence that the rude glacial finds in any case are implements at all? 4. Are deductions as to the habits, customs, arts, industries, institutions, and racial affinities of a people called for until at least one implement left by them is discovered, verified, and found to bear indisputable evidence of adaptation to or employment in some kind of use?

MODERN SYNTHETIC GEOMETRY VERSUS EUCLID.

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FOR more than two thousand years Euclid has held almost undisputed sway in the field of synthetic geometry. So strong a hold has it on school men that few American colleges dare offer anything else to freshmen. Is this because of tradition, or is there something in Euclid that makes it intrinsically better than anything mathematics has produced in modern times? To say that it holds its place merely because of tradition would probably be too severe a criticism, and would certainly call forth vigorous protest from its friends and defenders. To say that the wonderful advance in geometrical science in the last two hundred years has given us nothing superior to Euclid would be a doubtful statement, and almost an insult to the labors of such men as Monge, Poncelet, Carnot, Steiner, Von Staudt, and Cremona. No other branch of mathematics clings so tenaciously to that which is old, as geometry. In analysis, physics, mechanics, astronomy, everywhere but in geometry, the results and methods of modern thought are freely used, and no one doubts the propriety of their use. Why not take advantage of the same advances in geometry?

I have no quarrel with Euclid. It has been and is still a great factor in education. The severe training it gives in logical, clear thinking would be hard to equal. No doubt every student leaves Euclid with his mental powers greatly strengthened, and with increased ability to grapple with other studies and with the practical problems of life. Considered as to its educational value, but few objections can be urged against it. Mathematically considered, there are many things in favor of the modern synthetic geometry. Euclid is far more nearly a treatise on logic than on

mathematics. That a student succeeds well in Euclid does not argue that he will be a mathematician or even a lover of mathematics. Every teacher of experience knows how often his hopes, built on success in Euclid, have been dashed to the ground when the pupil began analysis. Euclid gives no hint of the mathematics which is to follow, and hence does not seem to fit in as an integral part of the science. Many of the proofs are long and tedious, with no hint whatever as to the method by which they were originated. The traditional limitations surrounding Euclid narrow the field of work by excluding almost all other mathematics, and thus must necessarily reach results that are special. The student who wishes to go on in mathematics finds himself almost totally unprepared for the next step.

Modern synthetic geometry meets all these criticisms. It is thoroughly mathematical, and the student who succeeds in it is assured of success in any branch of the science that he may undertake. Its steps are all logical, but logic is not emphasized as the end to be attained. It is constantly whetting the student's desire for mathematical study by giving him hints of that which is to follow. It also prepares thoroughly for trigonometry and analytical geometry. It is surrounded by no traditions, and so is free to use everything that serves its purpose. Its proofs are simple and direct, its results broad and general. Its symbolism and nomenclature are in harmony with mathematical science, and are at least two thousand years in advance of Euclid. It has a great fascination for the student, and classes are invariably enthusiastic over it. This year, as an experiment, one division of the freshman class in Indiana University studies the modern synthetic geometry, while the other divisions take Euclid. The modern synthetic class is by far the most enthusiastic, and gives strong evidence of the more rapid mental development.

The student who reads modern mathematical works must know the modern synthetic geometry. Modern writers appreciate its power, and use it freely. It is to be hoped that our American schools will give more attention to it. From a mathematical standpoint it is certainly desirable that it may soon entirely replace Euclid. The admirable elementary text-books of Dupuis of Toronto, Smith of Missouri, and Halsted of Texas, which have recently appeared, prove that the subject is growing in interest, and also make its general introduction more easy.

WEIGHTS AND MEASURES IN ENGLAND VERSUS THE DECIMAL AND METRIC SYSTEMS.

BY J. JAMES COUSINS, ALLERTON PARK, CHAPEL ALLERTON, NEAR LEEDS, ENGLAND.

IT is impossible for a comparatively new country like America to conceive the mode by which the English conduct their internal commerce, and the difficulties which exist in trading not only with foreigners but between the different portions of the United Kingdom, owing to the versatility of the weights and measures used in conducting her business, the different values of the varied denominations within the United Kingdom, and the many quantities represented by the same denominations when applied to articles of daily commerce.

If the ingenuity of man had been strained to the utmost to introduce a system of weights and measures calculated to throw difficulties in the way of commercial progress, to perfect a system that no one man has thoroughly mastered, and to place irritating obstacles in the path of education of both pupil and teacher, that end has been thoroughly attained, and, strange to say, it is the system pursued in the educational establishments throughout the kingdom at the close of this nineteenth century, although most of the colonies have set the Mother Country a better example.

Can anything be more absurd than the following? We sell "pickled cod" by "the barrel," "trawled cod" so much "each," whilst "large hooked cod" are sold by "the score," and "crimped cod" "per pound," shrimps by "the stone," soles by "the pair," Dutch smelts by "the basket," and English smelts by "the hundred."

This is the Billingsgate system, but at Grimsby (another important fish market) quite a different style of weights and measures is made use of, and the sale of fish is very much by "the box" and "the last."

A customer once asked a Grimsby fish salesman to let him have a stone of oysters. the reply was "We don't sell oysters by weight, we sell them by measure." "Then let me have a yard," said the buyer. Butter in Ireland is sold by "the cask" and "the firkin;" in England by "the pound" of 16 ounces, by "the roll" of 24 ounces, "the stone," and the "hundred-weight," which is not 100 pounds but 112 pounds.

Analyzing the quantities of the various denominations only makes confusion doubly confounded.

What is a "load?" A load of straw is 1296 pounds, a load of *old* hay is 2016 pounds, and a load of *new* hay 2160 pounds; but my tables do not tell me at what age hay becomes old.

What is a "firkin?" A firkin of butter is 56 pounds, a firkin of soap 64 pounds, and a firkin of raisins 112 pounds. A "hogshead" of beer is 54 gallons, but a "hogshead" of wine is 63 gallons, a pipe of Marsala wine is 93 gallons, of Madeira 92 gallons, of Bucellas 117 gallons, a pipe of port 103 gallons, and a pipe of Teneriffe 100 gallons. Again, what is a stone? A "stone" weight of a living man is 14 pounds, but a "stone" weight of a dead ox is 8 pounds, a stone of cheese is 16 pounds, of glass 5 pounds, of hemp 32 pounds, a stone of flax at Belfast is 16¾ pounds, but at Downpatrick 24 pounds, while a hundred-weight of pork is 8 pounds heavier at Belfast than it is at Cork—another injustice to Ireland.

England is slow to adopt new principles, but as more than 400 millions of people are using the metric system, surely it is time she took a step in that direction, a hint that probably may not be thrown away upon the grand American Republic.

In cataloguing the above absurdities of English measurement, I must not omit to inform you what quantities a barrel represents. A "barrel" of beef is 200 pounds; butter, 224 pounds; flour, 196 pounds; gunpowder, 100 pounds; soft soap, 256 pounds; beer, 36 gallons; tar, 26½ gallons; whilst a barrel of herrings is 500 herrings.

One example of the comparative merits of the existing system with the decimal system will suffice.

Reduce 987,654,321 inches into leagues. To arrive at this we must divide these figures by 12 to get them into feet, then divide the product by 3 to make yards of them, next by 5½ to find the number of poles, another division of the product by 40 exhibits the furlongs, then if the brain will stand it, for we have decimals in the quotient, we must divide by 8, which gives us the miles, and lastly by 3 to furnish the leagues, *quid erat demonstrandum;* and, if we have made no mistake, we have arrived at a satisfactory result.

To attain the same end by the decimal system, allowing the same number of denominations but each a decimal, no calculation is necessary, no sums to work out, but as there are six denominations, place the pointer on the left-hand side of the 6, the figures on the left of the pointer, viz., 987, show the number of leagues, whilst the figures on the right of the pointer furnish the fractions of a league, viz., 6 miles, 5 furlongs, 4 poles, 3 yards, 2 feet, and 1 inch.

Yet, can it be believed? the old system is taught in every school in England, and the cruelty inflicted upon the brains and the temper of the young, to say nothing of the loss of time and the cost, cannot fail to lodge a grave responsibility upon the legislature which permits such a condition of things to exist.

Nov. 4.

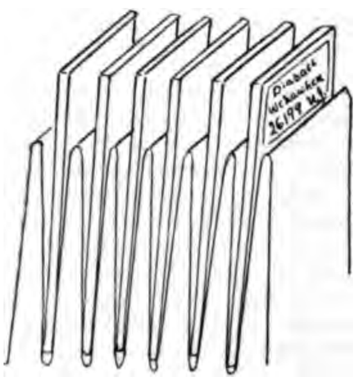
A CHEAP FORM OF BOX FOR MICROSCOPE SLIDES.

BY GEORGE P. MERRILL.

PRESUMABLY no one ever started out with making a collection of slides for the microscope but has wrestled long with the problem as to how they may best be taken care of. In the administrative work of this department the problem early became a serious one. For its satisfactory solution I am indebted to my brother, L. H. Merrill, then assisting me.

As it happened, we had in stock a number of paste-board boxes some 93 millimeters wide, 143 millimeters long, and 48 millimeters deep, all inside measurements. The dimensions of our standard slide are 48 × 28 millimeters. By means of two wooden partitions, some 3 millimeters thick, running lengthwise, each box was divided into three equal compartments, the partitions being held in place by glue reinforced by two small tacks at each end. Heavy Manilla wrapping paper, such as we also had in stock, was then cut into strips 25 millimeters wide and as long as the sheet of paper would allow, in this case about 7 feet. These strips were then bent into a series of folds, as shown in the accompanying illustration, the apices being rounded, not pinched flat. If carefully done, the folds when crowded gently together act as a spring. Two of these folded strips were then placed lengthwise in each compartment, and the slides introduced, standing on end, between the folds at the top. A box as thus prepared readily holds three rows of 50 slides in a row, or 150 altogether.

Each slide is separated from its neighbor in the same row by a double thickness of Manilla paper, which, owing to its manner of folding, acts as a spring, and avoids all possible danger of breakage. When all the compartments are filled, the space between the tops of the slides in any row is but about 2 millimeters; but there is, nevertheless, no difficulty in removing a slide or in getting at it to read the label without removal, since, owing to the yielding nature of the paper, the tops may be readily drawn apart. In this respect the box offers a great advantage over



those with rigid wooden compartments, such as are commonly in use. The first box was made merely as an experiment. It proved so satisfactory that, for the time being at least, it is the form adopted for storing the several thousand slides forming the museum collections.

I have attempted to show the arrangement as above described in the accompanying drawing. In reality the slides are held much more firmly than indicated, since the paper bulges and comes against both the front and back of the slides, the full length of the fold, instead of merely at the bottom. It will very likely strike the reader that a better material than paper might be found. I can only state that after considerable experimenting the paper was, all things considered, found most satisfactory.

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SPONTANEOUS COMBUSTION IN MINES.[1]

BY PROFESSOR ARNOLD LUPTON, YORKSHIRE COLLEGE, LEEDS, ENGLAND.

THE lecturer remarked that most of the difficulties of a mine could be overcome in certain well-known ways: water could be raised by pumping-engines; gas carried away by ventilation, and the danger obviated by safety lamps; but spontaneous combustion, in some cases, could not be prevented, and, when once begun, could not always be stopped, except by filling the pit with water.

Spontaneous ignition of coal was well known to ship-owners and insurance companies, large cargoes of coal being especially liable to take fire upon long journeys. In the same way, a great heap of coal on the surface was liable to take fire, especially if it was small coal or slack. For that reason it was necessary in storing slack not to have the heaps too wide or deep. A heap ten feet deep might not fire, while a heap twenty feet deep of the same coal would be very liable to fire. A small heap of slack laid against the outside of a boiler-flue or steam-pipe would probably take fire in a short time. Heaps of slack and broken coal left in the mine were very liable to take fire, and much smaller quantities would fire in the mine than on the surface, because it was warmer underground, and the superincumbent strata upon the slack and broken coal prevent the heat from escaping. Spontaneous ignition was very frequent in the thick coal-miles of South Staffordshire, Warwickshire, and Leicestershire, and it was necessary that these pits should be watched every hour of the day and night lest a fire, having broken out, should obtain the mastery before it was discovered. If a fire was detected whilst yet smouldering, the heated material is dug out if possible and the place filled with sand. Sometimes the fire was extinguished by pumping water onto it. In some mines water was laid on at a high pressure for the purpose of throwing jets of water onto any fire that may occur. It was usual, however, in mines liable to spontaneous combustion, to separate the district containing the waste heaps of slack or broken coal from the rest of the mine by means of walls or dams of brick and clay and sand, so that the smouldering fire, producing carbonic acid gas, extinguishes itself by its own smoke. Sometimes an apparently solid mass of coal took fire. In this case the apparently solid coal has been cracked and crushed, and air has been able to enter into the cracks to support combustion. In mines liable to this species of accident, the manager has a very anxious time, and his deputies must unceasingly patrol the pit. Sometimes it was impossible to isolate a fire, owing to air drawing through cracks in the pillars of coal surrounding the fire, and the men were beaten back by the flames, and had to abandon the mine. The shafts were then partially filled and covered so as to exclude the air, and in the course of three or four months it generally happened that the fire was extinguished.

The cause of these fires was perhaps not entirely explained. It used to be supposed that the decomposition of the sulphuret of iron, called iron pyrites, produced heat sufficient. This idea was, however, now abandoned by the leading chemists who had studied the question. Sir Frederick Abel and Dr. Percy, in a report to the Royal Commission in 1875 on the "Spontaneous Combustion of Coal in Ships," suggested the decomposition of the coal as the probable cause. Professor Vivian B. Lewes, in 1892, contributed a paper to the Society of Arts, in which he stated, as the result of the work of Richters and himself, that newly-cut coal would absorb oxygen to the extent, in some cases, of three times its own volume. This oxygen produced a kind of slow combustion, and, where the heat could not escape, the temperature of the mine was raised to that of 800° to 900° F., and at this temperature, if there was any air near to the coal, it would take fire.

There were only two ways, apparently, of preventing this spontaneous combustion. One was to cool the heap by ventilation. But the ventilation to be efficient must be equal to that of a coal-heap on the surface, and it was known that a heap of small coal twenty feet thick and thirty or forty feet wide was very liable to take fire; therefore, if the heap of coal in a mine was to be cooled by ventilation, the ventilating roads would have to be not much more than fifteen feet apart, and a cool current of air through each. This, as a general rule, was impracticable; and therefore, as a general rule, the prevention of spontaneous ignition by ventilation was impracticable. The other method was to exclude the air from the mass of coal that was liable to fire by means of walls of soft clay or by walls of brick and mortar and sand, or solid pillars of coal. The portion of the mine so walled off might get very hot, raising the temperature of the mine ten or twenty degrees above the normal temperature of the earth; but it could not take fire if the air was excluded.

[1] Summary of a lecture on the 10th of October last, at the Philosophical Hall, Leeds.

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[*Numerous complaints reach us of delay in receiving "Science" through the mails. It appears that it frequently takes a week for the paper to reach Illinois, for instance. This is owing to the small allowance of funds to the New York Post-Office, which prevents the employment of a sufficient force and compels the present force to work in decidedly over-crowded quarters.*]

THE PEDIGREE OF THE LETTER Y.

BY CANON ISAAC TAYLOR, LITT.D., YORK, ENGLAND.

IT is commonly asserted that our letter *y* is the lineal descendant of the Roman Y, which in the time of Cicero was borrowed from the Greek alphabet to represent *upsilon* in the transliteration of Greek names. This, however, is a mistake, as will be seen by tracing the history of the letter. It is only when *y* is used, as the Romans used it, as a vowel to transliterate *upsilon* in loan-words (either direct from the Greek or indirectly through Latin or French), such as *hyperbola, hydrostatics, hypocrite, tyrant*, or *myrtle*, that our *y* represents the Roman Y and the Greek *upsilon*. In the great majority of cases the English *y* is a semi-consonant corresponding in value to the Continental *j*, as in *young, yea, year, Yenisei, Yakut*, which in German are spelt *jung, ja, jahr, Jenisei, Jakut*. Along with the other Roman letters, the letter Y was adopted by the Anglo-Saxons from the Latin alphabet, with a value approximating to that of *i*, and hence the *y* in Anglo Saxon words has usually become *i* in modern English, or has lapsed into the neutral vowel, as in the words, *fyr, fyst, hyd, hyf, brycg, ynce, hyll, flyht, yfel*, and *wyrm*, which are now written *fire, fist, hide, hive, bridge, inch, hill, flight, evil*, and *worm*. In fact, there is not a single lineal descendant of the Anglo-Saxon *y* now in existence. The letter *y* in modern English words is, curiously enough, not a *y* at all, but a lineal descendant of the Anglo-Saxon *g*, which was the Roman G, evolved by the Romans out of an earlier C. This Anglo-Saxon *g* split into two sounds, retaining the old hard sound before or after the back vowels *a, o*, and *u*, as in *go, dog, gold, gum*, while before or after the front vowels *e* and *i* it weakened into a palatal semi-vowel; the words *ge, gese, gea, git*, and *gear*, becoming *ye, yes, yea, yet*, and *year*. A symbol which has acquired two values is frequently differentiated into two forms, thus *i* and *j, u* and *v* have come to denote respectively the vocalic and semi-consonantal sounds of the same primitive symbol. This happened with the values of *g*. The Anglo Saxon form ȝ came to be appropriated for the weakened sound, and the Caroline or Continental form *g* was used for the original stopped sound. In Middle English MSS., we have the two forms side by side, written ȝ and *g*. At the time of the invention of printing, this weakened *g*, written ȝ, had become almost identical in form with *y*, and accordingly printers used *y* to express it, while in Scotland a *z* in black letter (ȝ) was used for the weakened *g*, and in old Scotch books we fine *yet* printed as *zit*, and *year* as *zeir*, not that these words were pronounced with a *z*, but *z* was used for ȝ, as *y* was in England; just we write *viz* for *videlicet*, where the *z* is not the sibilant, but merely an old ligature for *et, videlicet* being formerly written *videlic*ȝ, in the same way as *libet* was written *lib*ȝ. So also the final *y*, so common in English words, is really the descendant of the final *ig*, equally common in Anglo-Saxon; *many, busy, any, greedy, silly, honey, holy*, and *day* being the Anglo-Saxon words *manig, bysig, ænig, grædig, sælig, honig, halig*, and *dæg*. This final *y* is so common a termination in English that, owing to analogy, it has replaced the old termination *ie* in other words, as in *academy, anatomy, homily*, and *irony*, where it represents the Greek *ia*, or in *jolly* and *tardy*, where it represents the French *if*. In *by* and *my* it has been introduced from analogy with words such as *dry, fly, sky*, where the *y* is really the weakened *g*. It will be objected that in certain words, such as "young" and "yard," an Anglo-Saxon *g* has become *y* before back vowels, but this fact is really only a confirmation of the rule, as in such cases the front vowel which modified the *g* has been lost, "young" being from the Anglo-Saxon *geong*, and "yard" from *geard*.

In the neo-Latin languages the same weakening of *g* before front vowels took place, but duplicate forms of the letter not being available to denote the two sounds, *g* represents both sounds, as in the case of the Italial words *gente* and *gallo*, or the French *géant* and *goût*, or else the *g* was replaced by *j*, as in *jouir*, from the Latin *gaudere*.

INSTINCT.

BY C. F. AMERY.

IT is now universally recognized that animals possess intelligence. The evidences on this head are too patent for dispute; but, like the guinea of the Primrose girls, it is supposed to be employed only in extraordinary emergencies. All the text-books on comparative psychology assume that all the ordinary pursuits of animals are instinctive, by which is implied automatic and mechanical; but whether instincts are to be regarded as impulses or as guides to action, or whether the activities are themselves instincts, is nowhere clearly defined in the text-books I have consulted. I purpose, in the present paper, to define the nature of instinct, and to indicate its place and the importance of its functions in the general economy of animal life.

The only satisfactory course of procedure is, first to collect and array the facts, and as man himself presents abundant illustration of all the psychological activities exercised in the animal kingdom, we cannot do better than examine the facts and study the nature and functions of instinct as exemplified in our own persons.

What then is instinct?

All the functions of the human organism and all the activities of life are classifiable under three heads — the mechanical, the reflex, and the intelligent.

The mechanical are the fundamental continuous processes of digestion, assimilation, circulation, secretion, and respiration. All these processes are performed unconsciously and involuntarily excepting respiration, which is performed sub-consciously and is to a small extent under the control of the will.

The reflex activities are automatic responses of the neuro-muscular organism to the stimulus sensations. They begin and end in the organism. In man, as in other animals, they are due to secretions in the system, to contact with external objects, or to special periodical or occasional conditions of the organism. They are all performed consciously by man, and are all susceptible of being brought more or less under the control of the will. The most common reflex activities are laughing, crying, sucking, masticating, swallowing, voiding the fœces and urine, coughing, sneezing, withdrawal from contact with objects, purposeless bodily exercise, etc. Laughing and crying may result from sensation, but they are sometimes reflex activities of the brain, originating in ideas.

Intelligent activities result from the perception of objects, their properties, and relations. Every effort for adjustment of the organism to external conditions apprehended through the senses is

intelligent. Touch is the connecting link between sensation and sense.

Instincts are not activities, but impulses to action. They are due to the sensations being transmitted from their several local seats to the brain, where they present themselves as cravings, desires, appetites, imperatively calling for relief. They prompt to two classes of activities, those which can be performed by reflex action of the organism, and those which require the adoption of intelligent means for their satisfaction. Hunger is a type of the latter, the impulse to void the fœces and urine may be taken as a type of the former. Among the most important instincts are the craving for food, the sexual, and the maternal instincts.

Instinct impels to action, but does not guide to its performance. It appeals to the mind like a squalling infant to its parents. If reflex action will appease it, it is simply a function of the will; if intelligent measures are required, it is the function of the intellect to adopt them. I may emphasize here, as bearing on what I shall urge later, that the most important instincts originate in the local action of proper secretions, as the contents of stomach and bladder, the gastric juice, the spermatorrhœal and lacteal secretions, etc., all provoking impulses essential to the preservation of the individual and the species; and no less important to man's intellectual development is the impulse to purposeless activity generated by the waste particles of the tissues on their way to the skin. Every psychological phenomenon has its physical basis, a self-evident proposition occasionally lost sight of in the discussion of instinct.

Up to this point it will be generally admitted that the vertebrate animals and higher insects are physiologically and psychologically close counterparts of man, the one essential difference being that their perceptions are all limited in range, while man's perceptions embrace the universe. The distinction appears to arise when we approach the subject of the inherited perceptions and working capacities. Many of the lower animals exhibit special inherited capacity involving clear perceptions such as man rarely exhibits without experience or instruction; and by almost common consent these special capacities and perceptions, although recognizedly the inheritance of the active intelligence of the species, are classed as "instincts." The classification which groups these psychological phenomena with impulses generated by secretions, is hardly a scientific one. Moreover, the accepted theory assumes that the species of so-called mental automatism exhibited, implies less intelligence than was displayed by the early parents of the stock in reaching the attained level of capacity, a view certainly not borne out by any degeneration of the brain; and, last, the advocates of the theory appear entirely to forget how much dexterity of brain and hand man has acquired by heredity. But before entering on this subject I want to make a few remarks on the function and importance of instinct in the economy of life.

Instinct is the schoolmaster of the intellect. Primitive man, looking around on his environment, would hardly have acquired a single perception of the properties and relations of objects, unless spurred to investigation by his instincts. The instinctive craving for daily food spurred his faculties to the discrimination of all the food substances presented to his senses. He soon acquired familiarity with the characters of every fruit, grain, root, etc., capable of appeasing his hunger, and with the characters and habits of all living creatures around him. In these matters he was fairly rivalled by the lower animals which, prompted by the same instinct of hunger and sense of danger, had their perceptive faculties equally aroused to the character of every thing that could be used as food by them, or that imperilled their lives. Man's hand was the wonderful organ which soon raised him above the intellectual level of the beasts; this, too, would have been useless to him but for the impulse to purposeless activity which besets him from childhood. Subject to this instinct he was, in common with his less-gifted fellow-creatures, under the imperative necessity of exercising every set of muscles and testing every organ in every direction of which it was capable of being used. In these exercises man at once became a being apart, by virtue of his hand. He was impelled to lay hold of every thing he saw, within the compass of his grasp, and whatever he laid hold of aroused his perception of its properties. He hurled stones and wielded sticks, revelling in the mere enjoyment of his powers, until gradually he acquired that experience of the properties of sticks and stones which suggested their application to the ever-present necessity of providing food. It must not be supposed that he advanced to a single idea without experience. He must have experienced the force of a blow from stick or stone, perhaps many times, before he conceived the idea of utilizing them as weapons of offence or defence. Once started on his path of progress, his daily experience constantly added to his stock of perceptions of the properties, and later of the possible uses, to which he could apply the objects he actually handled. There came a time in the progress of the race when man learned to reason from the known to the unknown, but primitive man was slow in developing this faculty. As regards every thing which affects their personal preservation and food supply, all the evidences point to the conclusion that the perceptions and reasoning powers of other animals are as keen and sure as savage man's; but, wanting the hand and the accompanying wider range of perceptions, their progress was limited to a narrower field. Only one mammal, the beaver, has developed a high constructive capacity. Why is this?

Remembering what was above said about instincts originating in secretions, it suggests itself that the castor of the beaver may possibly furnish a special impulse to activity in a prescribed direction, but this is not necessary to explain the dam- and castle-building talent of the beaver. The materials used in construction were the waste products of his food which he had to manipulate under conditions which compelled his attention to such of their properties as he utilizes. By taking them to the mouth of his hole, and floating them off when the water was low, he dammed the stream and raised the water to his hole. In arranging them about his hole to make room temporarily, his perceptions were trained in the direction of castle-building. Given the beavers primitive habits and the suitable environment, the direction of his evolution was as much a matter of constitutional necessity as man's. Fewer faculties were called into requisition in his case, but these concentrated on special labors attained greater natural facility of application, this added facility becoming in time constitutional in the species.

The wonderful constructive powers of insects have been developed subject to the same law, but for the most part these creatures enjoy special facilities for the development of their special capacities. They not only have special instincts due to special secretions, but in these secretions they have the materials of construction. The thread of the spider and silkworm, the wax of the bee, the viscid, and other special secretions of a hundred other insects, are all materials which would not excite their attention if they existed apart from themselves, but being under the daily necessity of manipulating them and being under a constitutional necessity of manipulating them in certain ways determined by the structure of their brain and manipulating organs, the species is forced to a perception of the uses they subserve, and are educated by experience to the point of engaging in their manipulation intelligently and with design. And just as the hand has played an important part in the evolution of man's intellectual faculties, so have the special secretions and special organs of insects necessarily produced like results. Their field of performance is limited in direction, but within their prescribed limits it is not unreasonable to suppose that they surpass man in the clearness of their perceptions. Within the field of their special activities they do not reason, they know. They reason only in emergencies.

This brings us to the final point and apparently vast distinction between the achievements of men and insects; and the arguments which apply here will hold good in considering the special aptitudes of creatures in other classes. The insects have inherited aptitudes for performing their special tasks without experience or instruction, ergo, it is argued, they are automatic, instinctive.

First with regard to the term instinctive, let us repeat here, the impulses generated by their special secretions prompt in all cases to the voidance of these secretions, but they go no further; the application of the voided material or its mixture into mortar

as with the white ant and mud-wasp are the results of intelligent observation and experience.

But it has become automatic! Brain and manipulating organs fulfil their allotted task without experience and instruction!

Here the parallelism with man is certainly no longer perfect; there is a divergence, but a divergence due only to the same laws acting on two sets of modified conditions. Man has developed by radiation in ever-widening circles and is still in course of an all-round development. The insect has developed along a narrow line and has reached the limit of his capacity, but that limit surpasses man's utmost attainments, both in clearness of perception without intellectual effort, and in facility of execution. The knowledge and capacity of execution gained by observation and experience have become constitutional. Man, in spite of the great breadth of his intellectual range, does occasionally reach something like the inherited clearness of perception and facility of execution of the insect, at special points of the circle; as, for example, in the inherited musical powers of a Mozart and other born composers, who have been capable of composing as automatically as the bee makes its cell; and I assume for both a similar intellectual gratification in the exercise of their powers. Look again at the born arithmeticians and mathematicians; or, again, at the achievements of a Siemens. Does any one suppose that these involve the intellectual labor performed by the average tyro struggling to overcome some petty difficulty? Great results have unquestionably been achieved by enforced attention and patient labor, but the greatest achievements arise by unconscious reflex action of the brain to the stimulus of inherited memories which evolves the idea before it even rises into consciousness. It is precisely this clearness of perception and facility of execution, recognized as genius in man, which characterize the special labors of insects and other of the lower animals in their special narrow fields. Further, all naturalists who have given close study to the hymenoptera, for instance, will, I think, support me in the conclusion that the automatic facility displayed in their special tasks is accompanied with intellectual resources which enable them to deal intelligently with emergencies which may arise in the course of their performance.

We may find a still closer parallelism between man and the lower animals in the matter both of inherited perceptions and capacities of performance on a lower intellectual plane, which being part of every man's experience, the relation of inherited to acquired ability will be the more readily appreciated. Every child knows intuitively that an apple is good to eat. On this point his perceptions are clear, his convictions not to be shaken. This is a familiar instance of inherited perception or brain memory. In fighting we have an illustration of muscle-memory. A fistic encounter calls forth as diversified and complicated a series of activities as almost any species of manual labor, but a ten-year-old boy of fighting stock will stand up to his first fight and play his part with a skill and address and promptitude such as he could not acquire in any industrial pursuit without considerable training.

These are only particular illustrations of a well-known general law. Any muscular or mental labor long persisted in is attended with a facility of execution which in time becomes constitutional in the race. Man is immeasurably removed from the lower animals by his wider range of perceptions and capacities, but we cannot form a better idea of the intellectual status of the lower animals, within their narrow limits, than by speculating on a future ideal stage of human evolution, when every child born into the world will, as his intellect unfolds, display, without instruction, the mathematical genius of a Euclid, the musical powers of a Mozart, the logical powers of a Bacon, and the comprehension of character of a Shakespeare.

THE DATE OF THE LAST GLACIAL EPOCH.

BY MAJOR-GENERAL I. C. COWELL, WINDSOR, ENGLAND.

Now that the untiring labors and vast research of such men as Professors Wright, Prestwich, and Emerson, Dr. Andrews, and Messrs. Gilbert and D. Mackintosh have resulted in such remarkable coincidences as to the period of the termination of the last glacial epoch, England, as America, may well be congratulated upon such achievements by their men of science in that intensely interesting field of enquiry; but our satisfaction would be far from complete if we did not find confirmation of these results in those of astronomical discovery, which give evidence of that perfect harmony which has so long been sought for in vain by astronomers and geologists and by all those who have awaited the revelation which unquestioned facts have at last disclosed. These are to be found in the beautiful discovery of Major-General Drayson of the Royal Artillery (formerly professor of astronomy at the Royal Military Academy at Woolwich) of the second rotation of the earth, whose works, entitled "30,000 Years of the Earth's Past History" and "Untrodden Ground in Astronomy and Geology" (published by Chapman & Hall and by Paul, Trübner & Co. of London), afford the most striking testimony to the accuracy of the calculations of the gentlemen referred to.

In so short a notice as this it is only possible to give a general outline of the discovery, which has occupied nearly thirty years for its full development, resulting in the discovery that the glacial period, or, more properly speaking, periods, occupy about 20,000 years, whilst the last terminated about 6,000 years ago. This, however, is but one of the results of the discovery.

The earth has three principal movements, the first being its daily rotation, the second the annual revolution of the earth round the sun, and the third a slow second rotation of the earth which causes the half axes of daily rotation to trace cones during a period of about 31,600 years.

The second rotation, more accurately defined, consists in the pole of the heavens describing a circle round a point, which is ascertained to be situated six degrees distant from the pole of the ecliptic, having a right ascension of 270 degrees, and at an angular distance from the pole of the heavens of 29° 25′ 47″, this angle depending upon the position of the centre of gravity of the earth, the earth being considered as a gyrating sphere, and so following the ordinary laws of gyration.

The two semi-axes of the earth by this movement describe cones, having their apices at the centre of gravity, which in the case of the earth nearly corresponds to the centre of the sphere. From the knowledge of this law, and from these data, the polar distance of a star can be at once calculated for more than a hundred years from one observation only, and to the decimal of a second of an arc, a result which hitherto could only be attained by constant observation and laborious calculations by the method adopted by astronomers in ignorance of the properties of this rotation.

The obliquity of the ecliptic can be ascertained for any time during the revolution of the poles, which are calculated to occupy 31,682 years in completing the circle. Hitherto the time supposed for the completion of this conical motion was about 25,000 years, during which period scarcely any variation occurred — so it was asserted — in the extent of the Arctic circles and tropics.

By a knowledge of the second rotation it is proved that a variation of twelve degrees in the extent of the Arctic Circle and tropics occurred not later than 13,500 B.C. The procession of the equinoxes is ascertained to be the result of this second rotation, and due to no other cause; and the rate of procession can be ascertained at any time, this, it may be mentioned, being proportionate to the sine of the obliquity of the ecliptic at the time indicated, in its every-varying amount from the minimum of 23° 25′ 47″ to the maximum of 35° 25′ 47″.

With such a difference, it follows that at the height of the glacial period — that is, when the obliquity attains to 35° 25′ 47″ — the Arctic Circle will have crept down towards the equator in both hemispheres twelve degrees, which will thus cause the tropics to extend to the same amount towards the poles, and so extend the tropical zone from Cape Hatteras to the River Plate.

Under such conditions the human mind fails to conceive the vast changes which must be brought about during every six months from the mighty floods caused by the intense summer heat and the intense cold of the Arctic winter, alternating with each other.

It is to such changes of temperature that we find the remains of Arctic and tropical animals imbedded together in the same

drift in their migrations towards those latitudes which their natures demanded, and so must man move in accordance with the necessities of the time as regards temperature and its consequences.

It is calculated that we are about 408 years distant from the time when the pole of the heavens in its revolution, the pole of the ecliptic, and that of the second rotation will be in the same colure — that is, in the year 2295 A.D.; and then the least differences in temperature between summer and winter will be experienced. From that time forward this difference will increase, and about 6,000 years later — or about the year 8300 A.D. — the earth will enter upon the next glacial period, and attain its greatest severity about the year 18,136 of our era; that is, when one half-revolution of the pole, occupying 15,841 years, will have been completed from the point indicated, of the pole and two centres being in the same colure.

The evidences of geology now attest the accuracy of this discovery, though twenty years later than it was discovered by this astronomer. Herschel, in his "Outlines of Astronomy," described the movement of the pole as describing a circle round the pole of the ecliptic as a centre and at a uniform distance from it of 23° 28′, though in another article he admitted a decrease of obliquity of 48″ per century; and these two contradictory assertions appear to have been copied or misunderstood by astronomers and mathematicians for more than a hundred years. Twenty-five years ago General Drayson pointed out the error, but no attention was paid to this. Now, however, all who look for the truth will receive a fresh impetus to independent enquiry, and signs of a change are already appearing which nothing can arrest, substantiated as his calculations are by the observations of the last 2,000 years.

In concluding these remarks, it may be observed that the axis of the planet Uranus very nearly coincides with the plane of its orbit, which varies only about 46′ from that of the earth, and astronomers, observing that its satellites moved in a contrary direction to that of the other planets, assumed that the satellites of Uranus "moved in opposition;" but General Drayson pointed out that this was not the case, and explained that it depended upon which pole of the planet was turned toward the earth which way the satellites would appear to revolve, whilst their real motion round the planet was not in opposition, but in conformity with the law that all satellites move round their primaries in the same direction.

It is possible that this discovery has never been suitably acknowledged by any scientific society, but in a work published in 1862, viz., "Common Sights in the Heavens," General Drayson, at pages 172 to 175, pointed out that former writers on astronomy had been in error in attributing to the satellites of Uranus a movement different from that of any others in the system. His geometrical proof of this fact is very simple, and it seems surprising, when we see the solution of the mystery, that writer after writer on astronomy should have copied each others' mistakes for more than seventy years.

Lastly, it is to be hoped that the discoverer of the second rotation may live to see the triumph which he has achieved universally admitted by all true lovers of science.

ALABAMA BAUXITE.[1]

BY HENRY MCCALLEY, UNIVERSITY, ALA.

BAUXITE was first discovered in Alabama in 1889. The first discovery was at the Dykes Limonite Banks, Cherokee County. Since then it has been found at the Walker Limonite Banks, near Jacksonville, Calhoun County, and at the Laney Old Manganese Banks, Cleburn County.[2] These deposits are all in the lower part of the Lower Silurian. The Cherokee and Calhoun deposits are at the bottom of the Knox Dolomite of Safford of Tennessee, now believed to be Upper Cambrian. The Cleburn deposit is in the upper part of the Weizner Quartzites, Middle Cambrian, believed to be identical with the Chilowee Sandstone of Safford. They are all in sections of country that are badly broken up by sharp folds and great thrust faults, and in which the characters of the rocks have been greatly changed, doubtless by the great heat produced in their folding and faulting. They are all pocket deposits, though they occur along regular leads and show more or less stratification in all of the cuts that have been made upon them. They occur about as do the limonite and clays with which they are closely associated, though they appear to show more evidences of stratification. They are so closely associated with the limonite and clays that their deposits appear to be greatest where the limonite and clay deposits are greatest.

The Cherokee deposits appear to occur along the crest of two sharp parallel anticlinals covered by *débris*, that run in a general north-east and south-west course and are from 150 to 200 yards apart. Between these anticlinals is a sharp synclinal, and it is more than probable that some of the bauxite deposits of the opposite anticlinals, as irregular stratified seams, are connected or are continuous, under the surface, across the synclinal trough. The largest limonite and clay deposits of this immediate section are in the synclinal trough, and it is believed that future developments will show the largest bauxite deposits to be also in the trough. The bauxite, in places at least, is on the top of a friable sandstone and under or in the lower part of an unctuous clay. The limonite is usually on the top or in the lower part of this unctuous clay. In places, however, there is bauxite seemingly on the top of the limonite, and in still other places it occurs in the clay as large masses and as small nodular concretions.

The Calhoun deposits, in the few shallow cuts that have been made upon them, also appear to be on the top of a sharp anticlinal. The Cleburn deposit has never been dug into and shows only as a few loose bowlders on the surface.

The Alabama bauxites have not as yet been dug into sufficiently to enable even a rough approximate estimate to be formed as to their quantity, still enough has been done on the Cherokee deposits to show that they alone have in them an immense amount of ore. They show on the dip in limonite old diggings to the depth of 75 feet. In one limonite old digging, the Dykes Bank proper, the bauxite, as an irregular seam about 60 feet thick, shows from the top to the bottom of the digging about 75 feet deep. This is the only place in which the full thickness is shown, though in half a dozen other places from a few feet to 50 feet in thickness of it can be seen. It has been seen by the writer at intervals on both of the anticlinals for a distance of about one and a half miles, and it is said to show at intervals on both anticlinals for a distance of nearly five miles.

The Calhoun deposits show at intervals in a north-north-east and south south-west course for about 250 yards. They have not been dug into sufficiently to show either the thickness or even the quality of their ore. In one of the pits or trenches, however, a thickness of about 25 feet of ore can be seen.

The Alabama bauxites are mostly concretionary or pisolitic, though some of them are earthy or clay-like. The eyes or concretions are usually of the size of a small pea, though sometimes they get to be irregular concretionary nodules of some two inches in diameter. The earthy or clay-like variety has often a metallic ring. The Alabama bauxites are of white, red, and gray colors.

The Cherokee bauxite, in car-load samples as sent to the manufacturers, is said by Mr. J. M. Garvin, superintendent of the Bass Furnace Company, Rock Run, Ala., to have about the following approximate analysis: —

Alumina, from	50 per cent to 60	per cent.
Ferric oxide, about	2.75	per cent.
Water, from	25 per cent to 30	per cent.
Insoluble matter, principally silica, about	7	per cent.
Titanic acid, from	2 per cent to 3	per cent.

This analysis shows the Cherokee ores to be of very fine quality. They carry, as said by the manufacturers, a somewhat smaller percentage of alumina than do the Baux, or France, ores with which they come in competition, but that they are more soluble, and hence are more valuable.

[1] An abstract of a paper prepared for the Fall Meeting, on Nov. 16, of the Alabama Industrial and Scientific Society.

[2] Since the above was written, it has been heard that Bauxite out-croppings have been found in two other places in Calhoun County, near Anniston.

Up to date only about 5,000 tons of bauxite has ever been shipped from Alabama. It has gone to Philadelphia and Natrona, Penn., and to Syracuse, Buffalo, and Brooklyn, N.Y., and to other places. It has been used principally for the manufacture of alum by the sulphuric acid method. The Alabama ores cannot be laid down in the above markets as cheaply as the Baux ores, and hence, if it was not for their superiority, they could not compete at all with the Baux ores. As it is, the profits are said to be small, and so it is not likely that the bauxite industry of Alabama will become very great until a home market is created for the ore. This, it is hoped, will soon be the case, as an aluminum plant is said to be now under way near Rome, Ga.

THE INTRODUCTION OF FOREIGN SPECIES.

BY JOHN GIFFORD.

NATURE maintains an equilibrium, and when this is interfered with by man evils ensue which are even more serious than the one he attempts to obviate. No man can predict the results of the introduction of an exotic animal or plant. Such a step should be attended with more study and caution than are usually exercised. One animal preys upon another to such an extent that by the introduction of other species the damage indirectly done is much more real than apparent.

When the cultivation of cane and the manufacture of sugar, molasses, and rum were at the height of their glory, the plantations of Jamaica were infested by rats. In order to rid the island of this pest the mongoose was introduced from India. In spite of the damage done to some of the domestic animals of the small property owners, the result was on the whole at first beneficial, since the prosperity of the island depended upon the products of the large plantations. Times changed, and the sugar industry faded. The negroes now have their own patches, and being favored by an indulgent Nature, with low ambitions and few wants, are forced to keep dogs to protect their poultry. They feel the loss of a pullet more than ever before. This class of people constitutes more than half the population. The mongoose has been increasing, and other small animals in consequence decreasing. Snakes are now extremely scarce, and many of the birds which nest on the ground have been destroyed. This animal inhabits both the lowlands and mountains, so that rats and mice take refuge in banana bunches, where they often build their nests. But these are only the direct consequences. Animals upon which this animal preyed fed upon other animals, especially insects. These have increased accordingly. Tics, for instance, which they say were introduced on South American cattle, have become an awful pest. There was no enemy to subject them, and only those who have walked through the beautiful pastures of this island, shaded with pimento and ceiba trees, can judge of their abundance. In crossing a pasture your legs become covered with these parasites, which, unless removed at once, bury in the flesh and cause much pain. While botanizing in the region of Mandeville, in the mountains, after each excursion the writer was forced to undergo a tedious operation: it was to have these tics picked out of the skin by negro boys, who have become expert by long practice, and many are the sixpences they have thus earned.

Out of revenge the Indians introduced the fer-de-lance, the ugliest and deadliest of reptiles, into Martinique and other West Indian islands. This snake increases rapidly in numbers, and many are its victims yearly. By the thickness of its skin the pig, and by its agility the cat, alone withstand this animal. Thus what they failed to do in war the Indians accomplished by a peculiar stratagem.

The abominable life-plant was introduced, perhaps as a curiosity, into certain parts of the West Indies. It has become a troublesome weed. It is impossible to combat or exterminate it. It grows in spite of you. Cut it up as you like, and it will sprout. Pull it up and hang it in a dry place or put it in your pocket, and from every indentation on the edges of its leaves there will come a sprout.

Every visitor to Nassau knows of the Giant Ceiba, with its far-reaching branches and curious butresses on the public plaza. This was planted by John Miller, and its history is of interest in showing how accidentally and rapidly the introduction of a species may be effected. He was a sea-captain, and traded to Brazil. He admired the ceibas so much that he brought home a seed or sprout to plant in his garden in one of our southern cities. He was a Loyalist; and when the War of the Revolution began he went to Nassau with his ceiba tree. This is the tree to which I refer — a tree many times photographed and described, the object of much admiration and the pride of Nassau. From the seeds of this others have come until now it is one of the commonest trees of the Bahamas. Thus animals and plants of benefit and detriment to a country have been almost everywhere accidentally introduced. In spite of warnings, grape-cuttings were introduced from America into Europe, and with them went the diseases of our vine with serious consequences. No matter how beneficial the introduction of a foreign species may at first appear, a sort of quarantine should be established, the government alone taking it in hand, introducing species only, after much study, with much caution.

New Orleans, Nov. 5.

PALÆOLITHIC MAN IN THE SOUTHERN PORTION OF THE DELAWARE VALLEY.

BY DR. HILBORNE T. CRESSON, PHILADELPHIA, PENN.

THE revival of the old feud in regard to palæolithic man is certainly a most interesting one, and I fully concur with my friend, Professor G. Frederick Wright, that "full discussion will dispel the uncertainty that may exist."

A great deal has been said about the finds in the Wilmington gravels (Columbian of McGee), and I notice that for some inexplicable reason the finds of others than myself have been ignored. I will give, presently, a brief *résumé* of the finds in supposed Columbian deposits, but before doing so it may be well to explain that I am not a professed geologist, but I do claim to have had the opportunity, by reason of a residence of twenty years in the vicinity of Wilmington, to study the aqueous deposits in that vicinity, and at times, in company with those who are authorities upon the subject. I take pleasure in quoting the names of Professors McGee and Wright and the late Professor Lewis. Messrs. McGee and Wright visited the Wilmington gravels at my request, and the former gentleman was accompanied by so distinguished an archæologist as Mr. W. H. Holmes of the U. S. Bureau of Ethnology. It was my good fortune to meet Professor Lewis at Claymont, during visits that he made to relatives who lived in a property adjoining my father's, and in these, our youthful days, we made many excursions over the gravels and brick clays which now bear his name. As Dr. Abbott suggests, in a recent publication in *Science*, "When I find gravel stratified and unstratified, I know and assert the difference," and it may be suggested, without conceit, that those who have spent years in studying glacial deposits, and searching among them for evidences of primitive man, aided at times by suggestions from the full-fledged geologist, ought to have some slight development of the perceptive faculty, in this respect, and be able to judge whether the condition of the gravels, in question, was disturbed or undisturbed, as the case may be.

During Professor McGee's visit to the Wilmington gravels (I have designated them thus, as Carpenter Station, on the Baltimore & Ohio Railroad, is but a few miles distant from this place), Mr. Holmes found what is now called, at the Peabody Museum, Harvard University, "the Holmes Palæolith." It is a piece of white quartz, bearing, according to the opinion of Professor Putnam, Dr. Abbott, Professor Wright, and Professor Wilson, evidences of artificial fracture. When the quartz in question was found by Mr. Holmes, I requested Professor McGee to examine the place from which it had been taken. He pronounced it to have been found in undisturbed Columbian deposits, but I here call especial attention to the fact that neither Holmes nor McGee deem the implement in question to be artificial. The palæolith was then submitted to Dr. D. G. Brinton for examination, who also condemned it. There is this to be said, however, that when

Mr. Holmes picked the implement out of a bank, among hundreds of other pebbles which surrounded it, he was attracted by its resemblance to a palæolith. If I recall our conversation at the time correctly, Holmes stated that although he believed the quartz to be a natural form, it resembled somewhat such implements. Certainly, then, this discovery is entitled to due consideration, for although the implement has been condemned by some, has it not received the approval of others who are also authorities upon the subject, among them Professors Putnam, Wright, Wilson, and Dr. Abbott.

Palæoliths have been found in the Columbian gravels at Trenton by Dr. Abbott and his son, Richard Abbott, according to the labels attached to the specimens preserved at the Peabody Museum, and presented by these gentlemen to that institution.

Two other palæoliths have been found in the Wilmington gravels by different gentlemen and are now in the Peabody Museum, Harvard University, together with the letters accompanying them. It has been suggested that they have been found in a talus. Whether this be so or not remains to be determined. I, some time ago, called attention to the fact that the old aqueous deposits in the vicinity of Wilmington have evidently been subjected to considerable disturbance (see remarks on a "Fallen Forest and Peat Layer," Bull. of Geol. Soc. Am., Vol. II.), and it may be that this took place in times comparatively recent. In fact there is a probability that this may have been even after "the ancient talus" at Trenton was deposited. I am predisposed to this opinion from the fact that during the extraction of clay from the pits at Richmond's brickyard (mouth of Naaman's Creek) leaves of oak and sycamore trees were found beneath the brick clays of Lewis, and in other portions of these excavations the more ancient and recent gravels were intermingled together among the fallen forest layers.

Implements have been found in the brick-clays just mentioned, and these are at the Peabody Museum with the records of the donors attached.

Looking over the list of finds in supposed tertiary and post-tertiary deposits, it appears that some class all of these as neolithic implements, that is, judging by the character of the implements themselves. May it not be queried, is the neolithic classification of European countries applicable to certain finds on our western continent? for it seems that some of our ancient deposits contain the handiwork of neolithic man. The antiquity of certain deposits which seem to have yielded in the majority of cases implements claimed to be of neolithic type is a question for the geologist to decide, until then arguments upon this subject have but little weight. Still, as we said in the beginning of this article, they are interesting; and, we may add, allow all concerned to express their opinions.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Natural Implements.

THERE are some things suggested by Dr. Brinton's recent article relating to early man in America, and three quotations may be made bearing on the subject of supposed primitive human art. It may be premised that no working archæologist has failed to find things of a puzzling character, those which he hesitates to retain as being of human workmanship, and yet which he is not altogether willing to cast aside. He accepts the fact, also, that many articles were so nearly fitted for man's use naturally that he often used them just as they were found.

An article, entitled "Observations on Stone-Chipping," by George E. Sellers of Illinois, prepared at Dr. Rau's request, was published in the Smithsonian Report for 1885, and is well worth reading. The various artificial processes are described, and some of the natural ones. He says: "The river-drift or gravel bars, when subjected to the grinding and crushing action of drift-logs or rolling bowlders, would furnish many suggestive forms and shapes that a little ingenuity would apply, and out of which would naturally grow the art of flaking. The streets of Paducah, Ky., are paved with partly rounded, angular, silicious gravel, mostly of jasper. Seeing heaps of this ready for spreading, I was struck by the many forms, mostly highly water-polished, that if found on a flaking ground would pass for refuse flakes and rubbish left by the workmen. On inquiry, I was informed that this coarse gravel was from banks on the Tennessee River, above the ordinary overflows. I selected many forms that any archæologist would pronounce to be the work of man."

He observed that a heavy wagon, driven over these, produced no effect on the surface gravel, but did on those lower down. "Many of the fresh fractures presented the form and appearance of genuine cores, and would be mistaken for the work of man." This led him to make an experiment by pressure, in a vessel. "On emptying the cylinder, the result was many representations of the rude implements found in the drift."

The second quotation is from a paper read by Dr. D. S. Kellogg of Plattsburgh, N. Y., at the New York meeting of the American Association for the Advancement of Science, in 1887, and entitled "Aboriginal Dwelling Sites in the Champlain Valley." "The material of which the chipped implements were made is found throughout this whole region. The so-called flint is abundant in the limestone of the locality. On Butler's Island in Lake Champlain detached pieces of the dark and striated flint, a foot or more in diameter, are so driven against each other by the action of the waves that their surfaces resemble the roughened surfaces of ordinary flint hammers."

The third quotation relates to the same lake, and will be found in the "Jesuit Relation" of 1668. The French had come within two miles of the Ticonderoga River. "Here we halted, without knowing why, until we observed our savages gathering from the shore pieces of flint, nearly all cut in shape." Then follows an Indian superstition connected with this customary gathering. "The occasion for this ridiculous story is the fact that the lake is often swept by severe storms, which cause high waves, particularly in the bay where Sieur Corlart, of whom we have spoken, perished, and when the wind comes from across the lake it casts upon the shore quantities of flint ready to strike fire."

There is one supposed trace of early man in New York that seems injudiciously used. Near the summit of the Lake Ridge, in the town of Gaines, was a spring, and in sinking a well on the spot traces of fire were found at the depth of eighteen feet. It is assumed that a fire was built on the beach when the lake was receding, and that it was buried in some way by the waters below it, under nearly twenty feet of soil. How this curious geological action was brought about is not explained. To produce such a deposit the waters should have risen above the fire, not fallen away from it. The probable solution might be that a fire was built in a ravine by a stream; that the ravine was filled in, turning the stream into a spring; and that other natural processes followed. That the lake could have buried the fireplace thus deep is clearly impossible. The depth by itself, however, is nothing very rare; but a field archæologist soon learns to distrust evidence of this nature. In some cases known to the writer, early villages and lodges, standing on open ground exposed to the wind, were buried in the sand, and the forest grew over them. The forest was cleared away all around, and the wind, with a wider sweep, carried the sand away again.

W. M. BEAUCHAMP.

Baldwinsville, Nov. 4.

Jealousy of a Dog.

IN an article in *Science* of Oct. 28, Mr. Stevenson remarks upon the jealousy of infants. Would you not place an infant of ten months upon a higher standard of development than a dog? Yet dogs are jealous. My brother owned one, a well-grown, bright fellow, who was usually upon excellent terms with my kitten but showed jealousy if the kitten was petted in his presence. On one occasion I held the kitten in my arms and

posely patted and praised it while the dog's eyes kindled ominously at the pretended neglect of himself. Suddenly the kitten jumped from my arms to the floor, and before I could interfere the dog had seized and shaken its little life out of it. I mention this as simply an instance. I believe that even birds show jealousy and sulk if too much notice is given a mate or a rival.

L. L. H.

BOOK-REVIEWS.

A Treatise on Plane and Spherical Trigonometry. By EDWARD A. BOWSER, LL.D. Boston, D. C. Heath & Co., 1892.

THE different treatises in Dr. Bowser's series of text-books are all characterized by an abundance of well-selected exercises. For class-room use this is a commendable feature. The accompanying texts, however, are often open to some criticism; they partake too much of the nature of compilations. It can be asserted that all such works are compilations to a greater of less extent, but such a claim is not always just. An author may go over the whole ground, making himself thoroughly familiar with his subject, then condense his materials, classify carefully, present in a comprehensive manner, allowing himself to be governed in all this work by well-known pedagogical principles. Against a text-book prepared in this way this charge could not, in justice, be brought. In a prospectus issued along with the trigonometry, his publishers state that Dr. Bowser is accustomed to bring out, on the average, one new volume a year. Whether such a feat is a matter of pride on the part of the publisher or the author does not appear. At any rate, it furnishes an explanation of the weakness as well as the strength of the series.

As a general rule, a presentation of a science which varies greatly from the historic development is likely to be more difficult to master than one which does not. Some authors of trigonometries actually reverse the natural order. If the student could commence just where Hipparchus commenced, with the relation between arcs and chords, and be shown the advantage in the use of a table of chords, and then led from that to a table of sines and thence to the other functions, the subject would be learned in its true bearing from the start. It is true trigonometry was for centuries regarded merely as an introduction to astronomy, the result being that the spherical part was developed abnormally. But from the days of Regiomontanus (Cantor, II., p. 242) it was studied as an independent science and grew accordingly. As topics in a natural treatment of plane trigonometry we might have: Arcs and chords; chords and sines; sines and the other functions; these functions in the solution of right triangles, exercises; solution of oblique triangles by dropping perpendiculars, exercises. Principle of continuity; angles and functions in other quadrants; fundamental relations between the functions; derived relations. Addition and subtraction formulæ, including all formulæ which are easy consequences. Cases in the solution of oblique triangles, with exercises, deriving appropriate formulæ as needed. Logarithms; solution of triangles by logarithms, model arrangements, exercises. Solution of trigonometrical equations, De Moivre's theorem, and such other topics as it may be thought best to insert. It is a grave pedagogical mistake not to use the natural tables first, and until the student is made to *feel* the need of some labor-saving system. The use of the functions and the use of the logarithms are entirely distinct, and should be well separated from each other in the mind of the beginner. The natural tables were calculated to fifteen decimal places the century before Napier invented his logarithms. To sum up in one sentence, there should be more of historical evolution in the presentation of trigonometry.

Let us test the plane portion of the present work by the principles suggested. After giving the ratio definitions of the functions first, the student is plunged into the generalized conception of arcs and functions. Next the addition formulæ are given and all their corollaries, which means a considerable part of theoretical trigonometry. Next, logarithms and the log-function tables are

CALENDAR OF SOCIETIES.

Chemical Society, Washington.

Nov. 10.—F. P. Dewey, Crystallized Sulphite of Zinc; W. D. Bigelow, On the Viscosity of Sorghum Juices. Mr. Dewey's paper first reviewed the literatures of sulphite of zinc from Berthollet (1789) to Deniges (1892), showing that most of the early investigations were occupied with the complex action of SO_2 on metals, in which the production and examination of sulphite of zinc was merely an incident, and while some had produced the sulphite by the direct union of ZnO and SO_2, only a few had produced it by double decomposition. Two formulæ have been announced. The first $ZnSO_3\ 2H_2O$ was proposed by both Muspratt and Forclos and Gelis in 1843, upon meagre analytical data, followed, in 1844, by Dr. Koene with quite satisfactory results. In 1845, Rammelsburg announced the formula as $2\ ZnSO_3\ 5\ H_2O$, which was supported by Marignac, in 1857, in an elaborate and complete examination. Finally, in 1892, Deniges somewhat arbitrarily announced that the formula must be $2\ ZnSO_3\ 5H_2O$. Mr. Dewey's first results, which were all obtained by dissolving ZnO in SO_2 water, clearly and unmistakably supported the earlier (1-2) formula, but, on repeating Denige's work, the later formula (2-5) was obtained. Finally, from the same solution of ZnO in SO_2 water, both salts were obtained. By allowing the SO_2 to go off slowly, a crop of small, powdery crystals was obtained, showing the 2-5 formula. The mother-liquor from this salt was heated to drive off SO_2 quickly, when quite large and distinct crystals were obtained, which gave the 1-2 formula, thus showing that the salt crystallizes with two proportions of water, and that both formulas are correct. It was also found that sulphite of zinc heated with free access of air is completely decomposed and yields an oxide carrying less than 0.01 per cent of sulphur. W. D. Bigelow read a paper on the Viscosity of Sorghum Juices. About one hundred juices of different specific gravity were taken and the amount delivered by a 50 cubic centimeter pipette was carefully weighed. This was deducted from the true weight of 50 cubic centimeters of the juice and the result taken as loss due to viscosity. From this it was estimated that a 50-cubic centimeter pipette would deliver from 49.5 to 49.9 cubic centimeters of the juice. It was also noticed that the most varying results were obtained from different juices of the same specific gravity.

Biological Society, Washington.

Nov. 19.—Theobald Smith, On Certain Minute (Parasitic?) Bodies within the Red Blood Corpuscles; C. W. Stiles, The Topographical Relations of the Excretory Canals of Cestodes; David White, A Walchia from New Mexico; F. M. Webster, Some Entomological Factors in the Problem of Country Fences; F. V. Coville, Comparative Value of Plants in Determining Floral Zones.

Appalachian Mountain Club, Boston.

Nov. 9.—John Ritchie, Jr., The State Park on Temple Mountain, N.H.; John Coleman Adams, The Brook Path up Chocorua.

explained. Chapter V. treats of the solution of trigonometrical equations. Then the formulæ for the solution of right and oblique triangles are given in full, and a lot of theorems on inscribed and escribed circles with a large number of exercises. Finally, on page 166, the first right triangle is solved, by logarithms of course! Then follow the other cases in the solution of triangles.

The last two chapters of the plane trigonometry treat very properly of the construction of trigonometric tables and De Moivre's theorem. In a foot-note, De Moivre is called a French geometer. It is true he was born in France, but he should rather be styled an English mathematician. In another note (page 91), speaking of the Naperian system, the author says it is so called from the inventor. Baron Napier. He should have said it is so called *in honor* of the inventor of logarithms. He gives the date of the introduction of Briggsian logarithms as 1615. They were suggested to Briggs in 1615, or about that time, but they could not be said to have been introduced until two years later. It is odd that in such a small number of historical references the author should have contrived to make so many mistakes. He calls arc sin, etc., the French, when he might have described it as the continental notation. Referring to addition and subtraction logarithms, he names only J. Zech, Berlin, as compiler of such tables. One would expect reference to Gauss, if to any one. There are numerous minor points which are quite worthy of commendation, but, on the whole, in the writer's opinion, the trigonometry is not nearly as satisfactory as other volumes in the series.

AMONG THE PUBLISHERS.

THE Open Court Publishing Co. will issue for the holidays "Truth in Fiction, Twelve Tales with a Moral," by Paul Carus.

— Besides the serials which begin in the November and December numbers of the magazine, *The Century* has in preparation for the ensuing year many other important features, only a few of which can be mentioned here. "Good Roads" will be one of the subjects, the important matters of street-paving and railroad-crossings being treated by men well qualified to discuss the questions. Papers on educational institutions and methods in America are in preparation.

— The December *Atlantic* will contain a description of being "Alone on Chocorua at Night," by Frank Bolles, author of "Land of the Lingering Snow."

— A semi-centenarian: America's venerable and only weekly eclectic, *Littell's Living Age*. This standard weekly is the oldest concentration of choice periodical literature printed in this country. It holds a unique position in the magazine world — a monthly that comes every week—a single magazine that contains the cream of all. Those who desire a thorough compendium of all that is admirable and noteworthy in the literary world will be spared the trouble of wading through the sea of reviews and magazines published abroad; for they will find the essence of all compacted and concentrated here. Its prospectus for 1893 presents some special attractions and is well worth attention in selecting one's reading-matter for the new year.

— With the number for November, 1892, *The Century Magazine* began a new volume. In November is also given the first instalment of "The Letters of Two Brothers." This series consists of extracts from letters which passed between the late General Sherman and his brother, Senator Sherman, at critical periods in American History, and are edited by General Sherman's daughter. Other serials beginning in this number are on "Science and the Bible;" the first paper, "Does the Bible Contain Scientific Errors?" being by Professor Shields of Princeton; to be followed by "The Effect of Scientific Study upon Religious Beliefs." The December *Century* will be a thorough-going Christmas number, full of Christmas stories, Christmas poems, etc., and with many full-page and other illustrations.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale or exchange.—A Stevens' new model pocket shot-gun, 44 cal., with 22-cal. rifle barrel. Just the thing for collecting birds and small mammals. Will exchange for a 22-cal. cane-gun or good books on ornithology. Write for particulars, stating what you have for exchange. R. C. McGREGOR, 2841 Champa st., Denver, Col.

For sale.—A very fine stone sword (?) so named by myself. It is perfect—15 inches in length, a little over 2 inches in width, and ½ inch thick. It is of a dark slate color, perhaps limestone, and is the largest implement of the kind known. Some fifteen years ago, when it was not mine, I was offered $40 for it; since that time it has come into my possession; that price will now buy it. Address Rev. C. FOSTER WILLIAMS, Ashwood, Tenn.

For exchange. — Fine specimens of Wis. fresh-water pearls. I want books or papers on marine and fresh-water algæ; also classified specimens of same. I will exchange for Smithsonian reports or crystallized minerals. D. M. ANDREWS, Dodge Centre, Minn.

For Sale or Exchange.—The undersigned has a lot of first-class duplicate bird's skins and sets of eggs, both rare and common, for sale or acceptable exchange. Also about two hundred second class skins and five hundred eggs, suitable for study specimens, at very low figures. The latter, for starting a collection, are as good as the best, embracing all classes and nearly all families. Also about forty species of fossils, principally Devonian. MORRIS GIBBS, M.D., Kalamazoo. Mich.

For Exchange—"The Birds of Kansas,"—Goss, for Gray's Anatomy, or Medical Dictionary. Must be in good condition. Address, J. H. SIMPSON, Buchtel College, Akron, Ohio.

Wants.

A POSITION is desired in the South, preferably the Gulf States, where I can teach the sciences. Can also instruct in other branches. Salary only nominal, as I am simply desirous of employment while spending the winter in the South. A private family preferred, but will accept regular school work if not too confining. MORRIS GIBBS, M.D., Kalamazoo, Mich.

WANTED.—By well-qualified and experienced science master and associate of the Royal School of Mines, London, aged 26 (at present in England), a mastership in technical college or university for any of the following subjects: Engineering sciences, geology and mineralogy, physics, chemistry and metallurgy, etc., etc. Can provide excellent references and credentials. Apply, J. G., 17 Sussex St., Rochdale, England.

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CHEMIST AND ENGINEER, graduate German Polytechnic, Organic and Analytical, desires a position in laboratory or chemical works. Address 313½ E. 7th Street, New York, care Levy.

SCIENCE

NEW YORK, DECEMBER 2, 1892.

?NITY FROM LEPROSY OF THE FIFTH GENERATION.

BY ALBERT S. ASHMEAD, M.D., NEW YORK.

: is a fact which, I believe, bears very directly and very upon the subject of non-contagion of leprosy. It is ed by all Oriental leprologists that every child of a leper aheritance of the disease, but diminished, and that after th generation, if no healthy blood intervenes, the disease ly extinguished. There is about these matters a very in- ; law in China, and consequently in Japan, the latter 1 spite of its western civilization endeavors, much more ive to Chinese traditions than to European ideas. I find ssed in Virchow's Archives by Dr. Friedel, in the follow- ls: —

marriage with children of leprous parents is allowed. iy appears in a family formerly clean, all betrothals and s of marriage previously entered into are rescinded as a of course. Only when the betrothed or married persons the same degree and type of leprosy, for instance, if they of the fourth degree of generation, the alliance stands. ial degrees of age of the morbid cases are allowed to con- mselves by marriage. A leper of the fourth generation, he no longer shows any external marks of the disease, marry a woman of the same degree of age of the disease: fspring is free from leprosy, and no longer forbidden intercourse."

we have, then, a perfect immunity acquired in four gen- , and the fifth generation restores the health of the race. s certainly a connection between this extinction of the and the present immunity of Europe, after that part of ld had been a prey to leprosy during several centuries of ldle ages. Evidently in the west, simple isolation has iously accomplished in the lapse of time what a rational on tries to bring about in the east. This legislation has preserved the populations of China and of the east in from entire destruction. I do not mean to say that the lways and carefully adhered to, because in that case the would be extinct now; but the rule is sufficiently known, ficiently adhered to, to make its salutary consequences

ion then, and exhaustion of the pathological principle, e course of four generations, are the only methods known acquiring immunity. Wherever the disease still exists, violation of that law, with which all the Oriental priests tors are so familiar, that has kept it alive. I had occa- ut a year ago to speak of these matters, at a time when as very much and very silly newspaper talk about the arising from the presence of a few poor leprous Chinamen York. I beg permission to reproduce here my whole ar- ich I sent at that time to the *Tribune*, and which was d Aug. 9, 1891.

recent appearance of several Chinese lepers in New York, fact that they are permitted to pursue their avocation for at least, among us, suggests to me the following points t may be useful to consider in our conduct towards indi- of that kind, which the abundant flow of immigration ing to our shores:

eprosy in China is very frequent; in the province of Quang- f which Canton is the capital, alone, there are at least epers; in all the maritime provinces of the South it rages e greatest intensity. It abounds, also, in Hankow, Cen- na. Outside of Canton, *in its province*, there are many leper villages, also along the Yang-tse-Kiang, as has been noted by several European observers. As to the interior of China, our knowledge of leprosy, of course, is derived solely from indigenous information. We know that the disease is more frequent in Quang-tung, Quang-sae, Hoonan, and Fuh-kun. In Pekin leprosy is rare. It is a generally admitted fact that it has not spread beyond the regions where it is established. Of course, it should be a rule at San Francisco to obtain information as to the part of China where the Mongolian immigrant comes from, if such a thing is possible. At any rate, might not a certificate of health be required of him?

"2. The Chinese believe that the disease may be communicated by the contamination of food. This generally received opinion must seem to us strange at first; but the fact that the lepro-bacillus is found in greater abundance in the mucous membranes about the mouth, throat, and nose lends it a certain degree of plausibility. Now, the Chinese established among us preserve, as everybody knows, all the customs of their own country. One of these customs consists in grouping together and eating their rice from the same bowl with those chopsticks which are promiscuously used by the whole house. If there is really something in the Chinese views of food infection, the necessity of isolating a leper from his countrymen is evident.

"3. The Chinese Government believes that leprosy is contagious, but it does not seem as if the people shared in this belief. There are asylums to isolate lepers all around Canton; laws and regulations have been issued with the same views. Yet, in spite of the regulations, the leper may enter any city by paying a certain sum of money, which goes to the leper fund. Altogether the Chinese act as if they did not believe in contagion. Nobody thinks of refusing to buy from a leprous huckster; provisions are bought fearlessly in the store of a leprous caterer. The disease, we may therefore admit, cannot easily be communicated by contact. Yet if there is any danger in contact, then we may be sure that the Chinese among us, true to their traditional customs, as they are, will do nothing to diminish it.

"4. But even the Chinese believe, with many other Eastern nations, that leprosy is communicated by cohabitation. Their laws recognize this fact. Some strange superstitions show how much the people are convinced of it. It is a belief among the leprous women of China that a woman affected with leprosy can be cured by cohabitation with healthy males. Whether we admit the Chinese theory, or are inclined to doubt it, we cannot absolutely condemn it, and therefore should not legal obstacles be put in the way of such intercourse between the two races? At any rate a leprous Chinese should under all circumstances be sent back to his own country.

"5. To allow the leprous male intercourse with healthy women is simply to strengthen and nourish the lepro-bacillus. The strength of the latter is gradually attenuated as lepers breed with other lepers, so that after a certain number of generations the obligate parasite is extinguished. This is the law of hereditary transmissibility, which has influenced all Oriental legislation, inasmuch as marriage between recognized lepers is permitted, while between a leper and a healthy person it is prohibited. This tendency to further disease, produced by the admixture of healthy elements, may not be apparent at the first forthcoming generation. The disease sometimes skips a generation or two and remains latent, until the third or fourth, perhaps, it meets with susceptible material. As long as there is a leper here, unrestrained in his actions, there is evidently danger of his perpetuating the disease among us.

"6. It must not be believed that we are absolutely and under all circumstances safe from leprosy. It is true that European residents in China, even where their contact with the natives is very close, catch the disease only when they un-Europeanise themselves altogether, that is, eat and live with the natives on

the most intimate terms. But then, under these circumstances, they catch the disease. As there is no danger here of such identification of the two races, we need no protection from a board of health for our own persons; but if some restraint is not put upon the intercourse of the races future generations, even here, may have to pay for the imprudence of their fathers. It seems to me that it is the duty of our National Board of Health to send back to their own country the lepers who have it now in their power to poison several generations and to establish a horrible disease, to be exempted from which we have considered hitherto a precious privilege, and thanked God for it."

It follows from all that I have said that the danger from leprosy does not arise from any contagious action, but from the continual redintegration of the disease, which results from the intercourse of lepers with healthy individuals. Contrary-wise to what would happen in syphilis, this intercourse strengthens and perpetuates the evil. As a matter of fact, no greater difference can be imagined in the etiology of two diseases than that which exists between leprosy and syphilis. I may here call the attention of all dermatologists to the well-known Colles law. According to that law, a woman who bears a child to a syphilitic man acquires perfect immunity from syphilis. Now, nobody doubts, either in China or Japan, that a leprous woman bearing a child to a healthy father acquires some measure of immunity; while the child receives and transmits the susceptibility. This is a fact diametrically opposed to those which are included in Colles law.

An assimilation, in whatever degree of leprosy and syphilis, has been made by many otherwise acute observers. Yet, what a difference in regard to contagiousness; for instance, there is in the fact that one disease, breaking out at the age of puberty, spares the race, while the other congenital, appearing with the appearance of the individual himself (both parents being supposed to be syphilitic) would destroy the race. In leprosy the intervention of pure blood acts as a nourishment to the disease; in syphilis, it attenuates the virus. The attenuation of germs, when they are allowed their regular course, seems to me to be of more general application. It is believed in Japan, that a child of parents who enjoy immunity from small-pox, by having had the disease, possesses itself a natural immunity (not a perfect immunity) transmitted to it. This was the greatest obstacle to the introduction of vaccination into Japan: artificial immunity of the parents, they said, would interfere with the natural power of resistance of the child. Variolization (if I may coin the word) and syphilization were always popular in Japan, in consequence of these same traditions. The complete devitalization of our introduced vaccine virus, after a certain series of inoculations, when a new virus had to be imported, proves that these Orientals were right. The devitalization of the germ of syphilis, which has occurred in Japan, after thirteen centuries of syphilitic inoculation, proves also that a natural immunity is acquired by the very transmission of the disease.

Let me say now what I believe must be rationally deduced from all I have said: What is generally called contagiousness does not essentially belong to the disease itself, it is entirely in the individual who contracts it. Its measure is that of the resistance of the individual or of the race. In four generations of lepers, regulated as I have said, the power of resistance becomes complete. In an unconscious, blundering, mediæval way, the resistance has been acquired by Europe. There is no place for the idea of contagion in these facts.

THE INFLUENCE OF THE MOON ON RAINFALL — A SYMPOSIUM.

I. — BY MANSFIELD MERRIMAN, PH.D., LEHIGH UNIVERSITY, SOUTH BETHLEHEM, PA.

THE widespread notion regarding the influence of the moon on the weather has probably some slight validity. The dispersion of clouds in mountainous regions under the influence of a full moon has been noted by several observers, as also the peculiar movement of thunder-storms. Yet little evidence, except of a negative character, has been derived by a discussion of rainfall statistics, although the rainfall is an element probably quite as liable to be influenced by the moon's changes as other elements. A series of observations, suitable in all respects for such discussion, is indeed difficult to find. The mean daily rainfall for a locality of wide area is not adapted to this purpose, for the moon's influence cannot be supposed to be the same under different topographical conditions. Even the daily records of rainfall at a single station may not be good ones if changes occur from time to time in surrounding buildings and trees, or if the gauge is placed at different positions in different years.

The observations of rainfall, taken at Bethlehem, Pa., by Mr. F. E. Luckenbach, during 1881-1890, are selected as the basis of a brief discussion, and they are believed to be free from the objections above noted. The amount of rainfall in each year was obtained for the day of new moon and for each of the three days preceding and following, and also for the other quarters. For each year a curve of rainfall throughout a lunar month of 28 days could then be drawn, and these curves were combined in various ways to endeavor to ascertain the features common to all of them. The following conclusions were derived: First, the new moon is liable to be followed by an increase in rainfall; second, the full moon is liable to be followed by a decrease in rainfall; third, the wettest period is generally at and preceding the full moon; and, fourth, the driest period is generally at and preceding the first quarter. These conclusions are, in general, most plainly marked in the years of least rainfall.

The first conclusion, that the rainfall is liable to increase after new moon, is perhaps the one most prominently observed in the curves for all the years. The frequency of rain, as shown by the number of days on which rainfall occurred, was also found to follow the same law. In the following table are given for each of the years the amount of rainfall on the two days before and on the two days after the day of new moon, as also the number of rainy days for each period. The number of new moons embraced in the table is 124, and in the last two columns are shown the number of times that this first conclusion was verified and the number of times that the opposite fact occurred. It is seen that every year except 1889 agrees with the conclusion as exhibited in the totals. The year 1889 was the one of heaviest rainfall, 57.68 inches, while 1881 had the least rainfall, 34.99 inches, the mean for the ten years being 45.68 inches. The probabilities of the respective occurrences, if based upon the totals for the ten years. are, hence, $\frac{51}{124}$ that rainfall will increase after the new moon, $\frac{34}{124}$ that it will decrease, and $\frac{39}{124}$ that rain will not occur either in the two da[illegible] in the two days after.

Rainfall for Two Days before and Two Days after New Moon.

Year.	Inches of Rainfall.		Number of Rainy Days.		Conclusion Verified.	
	Before.	After.	Before	After.	Yes.	No.
1881	0.22	3.69	2	5	5	1
1882	1.51	2.24	2	4	3	2
1883	3.07	3.14	7	8	4	4
1884	1.28	4.66	5	6	6	5
1885	1.23	2.03	7	7	4	4
1886	2.83	3.03	5	10	7	3
1887	3.07	4.75	7	11	6	3
1888	1.58	1.68	5	8	6	3
1889	6 13	1.87	7	8	4	7
1890	3.05	6.91	6	7	6	2
1881-1890	23.97	33.87	53	74	51	34
Odd years	13.72	15.41	30	39	23	19
Even years	10.25	18.46	23	35	28	15
1881-1885	7.31	16.79	23	30	22	16
1886-1890	16.66	17.08	30	44	29	18

The conclusion that the full moon is generally followed by a decrease in rainfall is not as plainly marked as the above, but the following are the total amounts in inches for the two days before and the two days after full moon:—

	Before.	After.
1881–1890	36.21	27.00
Odd years	14.76	12.51
Even years	21.45	14 49
1881–1885	16.31	10.54
1886–1890	19.90	16.46

The third and fourth conclusions, that the wettest period in the lunar month is near and before full moon, and that the driest period is near and before first quarter, are distinctly marked in the several mean curves. The mean result for the ten years is that 6.1 per cent of the rainfall occurred on the day of the first quarter and the two days before, while 13.8 per cent occurred on the day of the full moon and the two days before. In inches of rainfall the results for these two periods for several groups of years are as follows:—

	Day of Full Moon and two days before.	Day of First Quarter and two days before.
1881–1890	60.80	31.78
Odd years	23.64	13.76
Even years	37.16	18.02
1881–1885	20.76	12.65
1886–1890	40.04	19.13

The distribution of rainfall at and around the time of the changes of the moon has been the element most generally studied in connection with this question. In order that the records now under review may be compared with others, the following are given for periods of one day, three days, and five days respectively. These are for the ten years 1881–1890 and in inches of rainfall.

	Day of change.	Day of change and one day before and after.	Day of change and two days before and after.
New Moon	14.62	41.77	72.69
First Quarter	9.61	32.20	60.70
Full Moon	24.59	53.43	87.80
Last Quarter	21.34	49.67	78.29

These figures, like those previously given, indicate that the maximum rainfall occurs near full moon, and the minimum near the first quarter. It is impossible indeed to avoid the conclusion that at Bethlehem, Pa., during the years 1881–1890, the distribution of the mean rainfall seems to have been arranged with respect to the changes of the moon. If the moon really influences the weather it is to be expected that a connection will also be observed in other records, but it cannot be expected that the maximum and minimum rainfall in the lunar month will be similarly situated in all cases with respect to the times of change. I venture further the suggestion that, if the moon affects the rainfall, the greatest influence will probably be found in connection with thunder storms and local showers.

II.—BY H. A. HAZEN,[1] WASHINGTON, D.C.

THERE is hardly an idea regarding the weather so firmly rooted and so widespread as this, that the moon has a rather marked effect in bringing about its changes. This paper by Professor Merriman is a very interesting contribution to the subject. I desire to add a little to what he says, as his conclusions are not the same as those reached by myself. This matter has been thoroughly investigated in England and Europe with a negative result, except that there seems to be a slight influence of the moon, or perhaps the tide, on the occurrence of thunder-storms, and that the full moon seems to have power to drive away clouds. All the feasts and festivals in Germany are at the time of full moon. This, however, may be as much for the benefit of the light as the lack of rain. In the U. S. Monthly Weather Review for October, 1885, there is a short paper, in which it is shown that over this country as a whole there is a preponderance of thunder-storms during the new moon. While in New Haven, Conn., special research on this question showed that in that place there was, from 1878 to 1880, nearly a half more rain just before and after new moon than full moon. A farther investigation for this whole country, also for 100 years at London, England, gave a negative result; that is, no effect from the phases of the moon. In 1889 an investigation on the lower California coast gave a preponderance of rain during full moon.

It has occurred to me that it would be advisable to calculate the data at Philadelphia, Pa., which is not far from Bethlehem, for this question. I first computed the data for fifteen years, 1871–1885, and afterward for the ten years 1882–1891, with the result given in the accompanying table:—

	Amount of rain day of and one day before and after.		Amount of rain day of and two days before and after.	
	1871–85	1882–91	1871–85	1882–91
New Moon	66.66	42.03	108.38	74.31
First Quarter	59.38	29.09	102.26	50.63
Full Moon	60 36	44.12	94.60	60.80
Last Quarter	55.72	47.59	101.06	64.03

It will be seen that in the first period of fifteen years there is a preponderance of rain at the time of new moon, which corroborates the result previously obtained at New Haven. In the second period, for the three days about each phase the result is similar to that of Professor Merriman, though the difference of two inches between new and full moon is very slight. When we take the five days about each phase, however, we see that the new moon has 13.5 inches more rain than the full. I do not advance these figures as proving any influence whatever. It must be almost inappreciable if there is any at all.

A word may be added regarding the influence of the moon in driving away clouds. I have detected this apparent influence many times by closely watching the moon. Of course, if this is a fact, it would show that there must be a tendency to less rain at the time of full moon. It should be borne in mind, however, that the minimum of cloudiness occurs in the evening or before midnight, and this complicates the phenomenon.

[1] As Prof. Merriman's paper has not been seen, this must be regarded as an independent discussion of the subject and not a reply to that.—H. A. H.

RECENT BOTANICAL EXPLORATIONS IN IDAHO.

BY D. T. MACDOUGAL, LAFAYETTE, IND.

IN various parts of the region occupied by the ranges, spurs and foot-hills of the Rocky Mountains are large areas which have never been explored by the naturalist. The species of the flora and fauna of such regions can, to a great extent, be approximated by a knowledge of the contiguous territory, especially if a similarity of climate prevails, but in all cases every natural area of land, such as a river, valley, or mountain range, gives to its forms of plant and animal life certain differences from all forms found in other localities. If the differences are of sufficient importance, they will constitute new species, and in many cases whole groups or genera peculiar to a certain region are found.

The exploration of certain areas invariably brings to light numerous undescribed forms of both plants and animals besides affording valuable information on the distribution and variations of known forms.

At various times collections and observations on the flora of the Rocky Mountains have been made by attachés of geographical and geological surveys, and by the various parties engaged in the exploration and survey of railroad routes across the continent, by individual workers under the direction of the several divisions of the U. S. Department of Agriculture, by representatives of various scientific societies, and by collectors working entirely independently.

The amount accomplished in this way cannot easily be estimated, but it may be suggestive to know that "The Systematic and Alphabetic Index of New Species of North American Phanerogams and Pteridophytes," published in 1891 by Josephine A. Clark, "Contributions from U. S. National Herbarium," Vol. I

No. 5, shows that, during the year of 1891, 677 new species and 188 new varieties of flowering and fern-like plants were described. Perhaps one-third of these are simply old forms re-arranged, but these figures indicate that more than five hundred new forms among the higher plants, with no mention of the vast number of lower forms, have been discovered in this one year. Among the areas within the boundaries of the United States unexplored by the naturalist, may be mentioned north-western Montana, northern and central Idaho. These regions have been at various times penetrated by Hudson Bay trappers, missionaries, hunters, gold and silver prospectors, but our knowledge of the topography is comparatively meagre, and the best government maps are not even approximately correct, especially in central Idaho, with which this article is particularly concerned. In general, however, the following description obtains. (See map.) The broader southern portion consists in great part of the arid "sage" plains of the Snake River Basin. The surface is chiefly basaltic lava overlying porphyritic trachyte. This entire region is character-

ized by excessive changes of temperature. The central portion is a huge mountain mass upreared in places to a height of 13,000 feet, reaching far above timber-line and bearing extensive banks of perpetual snow.[1]

The jagged slopes are covered with forests of cone-bearing trees, with dense thickets of underbrush on the lower slopes. The principal formations are lava, granite, and forms of limestone and quartz.

The most prominent of the numerous short ranges comprised in this group are the Salmon River, Lost River, Clearwater, Sawtooth, Pahsimeroi, Craig, and Seven Devils Mountains. Extending northward along the eastern border and joining this central mass directly are the Bitter Root ranges passing northward into the Coeur d'Alene Mountains, leaving to the westward the semicircular basin drained by the Clearwater and Palouse Rivers and by the tributaries of Lake Coeur d'Alene.

North of the 48th parallel, Clark's Fork of the Columbia River cuts its way through the ranges and expands into Lake Pend d'Oreille, a cliff-encircled sheet of water, forty-five miles long and ten miles wide, with a depth of 1,800 to 2,500 feet. Northward, between the forks of the Columbia River, are the snow-capped mountains surrounding the elevated Lake Kaniksu.

For the season of 1892, Dr. Geo. L. Vasey, chief botanist of the Department of Agriculture, planned a survey of the basaltic basins of the Clearwater and Palouse Rivers, the country around the lakes Coeur d'Alene and Pend d'Oreille and the adjoining mountain ranges to the eastward, and, acting under the direction of Dr. Vasey, in accordance with this plan, a party of botanists composed of J. H. Sandberg, A. A. Heller, and D. T. MacDougal, with J. G. Brunswick in charge of camp, outfitted at Lewiston at the head of navigation of the Snake River, and went into camp on the north bank of the Koos-Kooskia or Clearwater River, April 23.

The camp equipment consisted of four native horses ("cayuses"), a mountain-wagon, harness, riding and pack saddles, a wedge tent for storage and sleeping-room, and a large wall tent for the routine work. To this may be added the usual number of woolen and rubber blankets, tarpaulins, cooking apparatus, medicine chest, fire-arms, etc. For the preparation of dried plants, 6,000 driers, 11½ by 17½ inches, and several times as many sheets of fine Manilla paper of the same size, were furnished; in addition, several packages of envelopes, for the reception of seeds and small plants; portfolios, tin boxes for collecting specimens, a varied assortment of picks and large knives for uprooting plants from soil and rocks; note-books for the accumulation of data concerning the habits and distribution of plants, and movements of the expedition, and an aneroid of doubtful accuracy and limited usefulness. The general plan of work was to pitch the main camp in a favorable location, generally near a stream or lake, where good forage, fuel, and water might easily be obtained. From this place as a centre, the immediate neighborhood within a radius of three or four miles would be worked over; this area would then be extended four to eight miles farther by the use of saddle animals, the collector returning to camp each day. Still more extended excursions, so far as 40 miles in some cases, were made by boats and pack-horses carrying the smallest necessary camp outfit and a minimum of apparatus.

All flowering plants collected for preservation were placed in the drying sheets on the same day on which collected, if possible, and a daily change of driers made until safely dried. These prepared specimens were then shipped to Washington whenever transportation was available.

After the region accessible to the camp had been thoroughly worked, the expedition would then move its entire equipment fifteen to fifty miles and pursue the same method. In this manner the route was carried from the first camp on the Clearwater River to the southern edge of its basin in the Craig Mountains about May 20, camp being made at Lake Waha. Up to this time the weather had been extremely unfavorable to field work and preparation of specimens, the journal showing that during the first twenty-five days rain and snow-storms had been encountered on twenty-three of them, it being, however, practically the end of the rainy season. At Lake Waha (elevation 2,500) the nights were extremely cool, and on the slopes a few hundred feet above it were huge snow-banks, in many cases a dozen feet thick. From Waha the expedition retraced its steps to the Clearwater camp, then up the Clearwater and its northern tributary, Potlatch Creek, making two camps on this stream and its branches. From here the route was through well-settled districts northward to the south-western part of Lake Coeur d'Alene, which was reached July 2, camps having been made near Moscow, Viola, and on Pine Creek. The expedition was joined at Moscow by Mr. G. B. Aiton, who participated for three weeks in the excursions made to the lower ranges on the east and isolated buttes in the basin. From the camp at Farmington Landing numerous bays and tributaries were explored by boat, and, by aid of one of the small steamers plying here, an excursion was made up the Coeur d'Alene River, and half the party ascended the St. Joseph River to near the head of navigation, forming a temporary camp near the base of Wessner's Peak at the ranch of Mr. C. P. Reid. An ascent of the mountain was accomplished July 6. Ice was found on lake near the summit, while snow-fields were numerous

[1] Dr. C. H. Merriam, "North American Fauna," No. 5.

and extensive although its highest part is far below timber-line. The expedition moved across the lake and passed Cœur d'Alene City, making a short stop on the north bank of the Spokane River, then northward, across a stretch of level prairie and the Northern Pacific Railroad, to the foot of a group of mountains whose highest peak is called Mt. Carlton. Sucker, Tesemini, and Fish Lakes were visited and some ascents were made.

In the latter part of July the camp was carried to the southwestern part of Lake Pend d'Oreille and located on the ranch of Mr. J. Lieberg, a miner and botanical collector who was of material assistance to the expedition in the excursions with packhorses made from this point to the mountains near the headwaters of the North Fork of the Coeur d'Alene River and to the top of Packsaddle Mountain on the eastern shore of the lake. The work here was carried on under great difficulties. The mountain slopes are very irregular, traversed by numerous cross cañons and covered with forests of spruce, fir, and pines, which have been in many cases invaded by fires throwing to the ground thousands of trees with the trunks lying across at every conceivable angle, forming extensive breastworks, which on the lower slopes are thickly grown with Ceanothus and higher with Menziesia so thickly as to form a nearly solid wall. A passage through such places was effected only by the liberal use of the axe — cutting small trees too near each other to permit the pack-loads to pass and logs too high to be taken by the pack animals. At times an animal would attempt to pass between rocks or trees narrower than the load, or loose its footing and roll to the bottom of the cañon below, necessitating a halt and rearrangement of loads. Such occurrences wrought many accidents to apparatus, material, and temper, and oftentimes made an advance of two or three miles a very creditable day's work.

Vast forest fires were raging at this time over northern Idaho, adjoining parts of Washington and Montana; all of the valleys, cañons, and lower levels were filled with a layer of smoke so that from the double crest of Packsaddle Mountain, the tops of the neighboring peaks, as far as the eye could reach, appeared as islands in this sea of pitchy fog. These fires are of widespread prevalence and of yearly occurrence, destroying thousands of acres of forest annually and threatening, in conjunction with the extensive snow slides that descend from the higher slopes, an almost entire destruction of the timber, forestalling, to some extent, the piratical timber-thieves that infest its borders.

The final work of the season was done from the northern end of the lake from near Hope, Idaho, and here at the end of the season the camp was broken and the corps returned eastward by rail.

Briefly summarized, the results of the expedition are as follows: The basins of Lakes Coeur d'Alene and Pend d'Oreille and of the Clearwater and Palouse rivers were explored; the botanically unknown area in Central Idaho now being limited on the south by the Snake River basin, on the west by the Snake River and the basin explored. About 25,000 specimens of dried plants were collected, representing nearly 1,000 species, many of them undescribed forms. Valuable facts concerning general distribution of plants were obtained, since the area explored is one where the Rocky Mountain flora meets and intermingles with the Pacific coast flora in a very interesting manner, while the opportunity afforded by numerous mountain slopes for the furthering of some problems of vertical distribution was not neglected.

BIRDS THAT SING IN THE NIGHT.

BY DR. MORRIS GIBBS, KALAMAZOO, MICH.

WE have no regular night-singers in Michigan, and, so far as I am able to learn, America does not equal the Old World nightingale, although we have diurnal songsters which excel. The famous English naturalist, Gilbert White, records three species of birds which sing at night in the British Isles. They are the reed-sparrow, which sings among the reeds and willows, the woodlark, singing in mid-air, and the nightingale, as Milton describes it,—

"In shadiest covert hid."

There are several species of owls which roll forth or screech out their notes at night, and also numerous shore-birds and water-fowl that issue their varied calls, and, especially these latter, are to be heard during the season of migration, as most birds are partial to night travel spring and autumn. Then, too, our well-known whip-poor-will confines his not unmusical, but monotonous jargon to the hours of darkness, while the scream of the night-hawk breaks on the ear between the setting and rising of the sun. But these birds are not, strictly speaking, songsters, although their notes undoubtedly fill their requirements as to harmony and expression.

The plain, domestic little chipping sparrow sometimes favors us with its simple reverberating chatter in the darkest of nights. The notes hardly deserve the name of song, but heard issuing from the surrounding gloom, the simple refrain commands our attention from its oddity at the unusual hour. The wood-peewee not rarely quavers forth its plaintive effort, sounding in the deep shade like a wail from a departed spirit. This favorite singer is a remarkably early riser, as he is also late in going to rest, and I have sometimes thought that his musical efforts at night were the result of an error on his part — an idea strengthened by the fact that the notes are rarely heard more than once during the night, and moreover the song is only occasional.

Two others, which are sometimes heard to burst forth in ecstatic melody, are the hermit and Swainson's thrushes. They are transients in my locality, but nest to the north of us. If I could describe the songs of birds, so that others could appreciate them as I do, I would feel that a partial acknowledgment had been made to the divine melody issuing from these birds' throats.

We often hear that the best singers are the ones of plainest plumages, but this is assuredly not so in all instances. If one is permitted to listen to the sweet song of the scarlet tanager in the night, it will be acknowledged that the brilliant coat of the songster does not compare in point of excellence to the owner's refrain.

These birds are the only species which sing during darkness, in Michigan, that I have met with, and not one of them is a regular night-songster.

NOTES AND NEWS.

THE College of Physicians of Philadelphia announces that the next award of the Alvarenga Prize, being the income for one year of the bequest of the late Señor Alvarenga, and amounting to about $180, will be made on July 14, 1893, providing that an essay deemed by the committee of award to be worthy of the prize shall have been offered. Essays intended for competition may be upon any subject in medicine, but cannot have been published, and must be received by the secretary of the college on or before May 1, 1893. The Alvarenga Prize for 1892 has been awarded to Dr. R. H. L. Bibb of Saltillo, Mexico, for his essay, entitled "Observations on the Nature of Leprosy."

— W. J. Waggener, Professor of Natural Philosophy, State University of Colorado, Boulder, writes: "During the present year, I have tried the experiment of making diagrams and pictures for projection by the magic and the solar lantern by printing the same with the ordinary printing press and engraved blocks, on sheets of transparent gelatine. The results were gratifying even beyond the expectations which I had long entertained for the process. It is safe to say that by this means excellent lantern-slides from diagrams and engravings of nearly if not quite all kinds can be made and multiplied as rapidly and almost as cheaply as paper prints. Having assured myself of the usefulness and the novelty of the process, I wish that its use may bring the unlimited benefits and pleasures of projected pictures to many who cannot afford the more expensive ones now in use. Especially I hope that all schools may soon be able to make use of this means of instruction. No patent will be asked for this process, but all are invited to make free use of it."

— Macmillan & Co. announce that the recently completed edition of Foster's "Text-Book of Physiology," in four parts, is to be supplemented by the issue of an appendix on "The Chemical Basis of the Animal Body," by A. Sheridan Lea, Sc.D., F.R.S. Dr. Lea is lecturer on physiology to the University of Cambridge, England.

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STATISTICS OF THE MISSISSIPPI RIVER.

BY H. L. WHITING, WASHINGTON, D.C.

PERSONS familiar with the range of tide along the seaboard can hardly realize how much the waters of our great interior rivers are affected by the rainfalls and watershed upon and from the vast surrounding valleys. The records of the Mississippi River Commission give much relevant data in regard to these phenomena. The following figures have been selected, from the voluminous reports of the Commission, to give more briefly a knowledge of facts that do not come before the general public. As an instance of the great rise and fall of the Mississippi River at Cairo — at its confluence with the Ohio — in the spring of 1891, at its low-water stage, the surface of the river was within a few inches of the top of the levee that protects the city of Cairo from inundation, and from the deck of the steamer the writer looked down into the streets of the city several feet below the line of the water rushing by with a velocity of nearly seven miles an hour. In the fall of the same year, at the low-water stage of the river, the steamer, at the same place, was fifty-one feet below the elevation at which she floated six months before; and this was not the greatest range of the river at this point.

Difference between highest and lowest water-readings.

Mississippi River.	
St. Louis, Mo	37.1 feet.
Cairo, Ill	53.2 "
New Madrid, Mo	41.4 "
Memphis, Tenn	34.5 "
Helena, Ark	48.0 "
Mouth of White River, Ark	48.4 "
Greenville, Miss	40.8 "
Vicksburg, Miss	51.1 "
Natchez, Miss	49.9 "
Mouth of Red River, La	48 5 "
Baton Rouge, La	36.0 "
Plaquemine, La	29.9 "
College Point, La	23.7 "
Carrollton (New Orleans)	15.9 "
Atchapalaya River.	
Simmsport, La	38.3 "
West Melville, La	30.4 "
Red River.	
Shreveport, La	25.5 "
Alexandria, La	40.2 "
Barber's Landing, La (Head of Atchapalaya)	51.1 "
Arkansas River.	
Little Rock, Ark	31.0 "
Pine Bluff, Ark	29.5 "
White River.	
Jacksonport, Ark	33.9 feet.
Clarenden, Ark	28.8 "
St. Francis River.	
Wittsburg, Ark	44.9 "
Tennessee River.	
Florence, La	30.4 "
Chattanooga, Tenn	54.0 "
Cumberland River.	
Nashville, Tenn	55.6 "
Ohio River.	
Paucha, Ky	54.2 "
Cincinnati, Ohio	69.1 "
Louisville, Ky (Upper)	45.5 "
Louisville, Ky (Lower)	71.0 "

Areas of Overflow.

St. Francis Basin, Commerce, Mo., to Helena, Ark. (east side of river) 6,090	2,874	sq. miles.
(west side of river)	3,216	"
Illinois, Kentucky, and Tennessee	616	"
White and Arkansas Basins (west side of river), Helena to Arkansas City	956	"
Yazoo Basin (east side of river), Memphis, Tenn., to Vicksburg, Miss	6,648	"
Macon, Boeuf, and Tennessee Basins (west side of river), Arkansas City to Red River	4,955	"
East side of river, Vicksburg to Baton Rouge	415	"
Atchapalaya Basin (west side of river), Red River to Bayou La Fourche	6,085	"
Pontchartrain Basin (east side of river), Baton Rouge to Gulf of Mexico	2,001	"
La Fourche Basin (west side of river), Donaldsonville to Gulf of Mexico	2,024	"
	29,790	

Nearly thirty thousand square miles, or three and a half times the area of the State of Massachusetts.

Although, as stated, the high-water depth of the Mississippi River at Cairo is over fifty feet, the low-water depth, on shoals and bars, does not exceed four feet. This great highway to the ocean is, therefore, at these latter seasons, practically unavailable for navigation. Ten of the large steamers of the Anchor Line, which ply between St. Louis and New Orleans, are now laid up, while the elevators of St. Louis have accumulated some nine million bushels of wheat, waiting transhipment.[1] This is but a partial showing of the importance of the improvement of the Mississippi River, in its low-water navigation, to the commercial interests of the country; aside from the injury to agricultural interests from the overflow of the lower basins of the river.

ON THE USE OF THE COMPOUND EYES OF INSECTS.

BY R. T. LEWIS, EALING, ENGLAND.

FEW subjects connected with the study of insects have given rise to more widely differing opinions than the rationale of their complex organs of vision, the physical structure of which presents to us one of the most elaborate optical combinations to be found in nature, and this, too, upon a scale so minute as to require no ordinary skill on the part of the microscopist to unravel its marvels.

Attempts to work out the problem as to what is the impression produced upon the consciousness of an insect by an arrangement so complicated have seldom resulted in satisfactory conclusions, not a few failures in this respect apparently being due to inadequately clear conceptions as to the application of the laws and phenomena of refraction to the cases in point. But whether the subject is approached from the standpoint of those who regard an organ as having elaborated itself in obedience to the necessities of

[1] November, 1892.

external conditions, or from the opposite position of those who aver it to have been designedly contrived to meet the special requirements of those conditions, it is a matter for surprise that any should have been found to express a belief that, for distinctness of vision and other purposes for which eyes are required, these specialized and elaborate contrivances are little better than optical failures. Such a notion, if capable of proof, would be a unique exception to that perfect adaptation of means to ends, which, wherever our knowledge is complete, we find everywhere else in nature.

Apart from the question as to whether the nervous structure of an insect's eyes enables it to utilize rays which are beyond the compass of our own, it is clear that the nature of light requires in all organs of vision a structure which is analogous in its optical principles; that is, there must be the means of forming an image, a sensitive screen upon which to receive it, and a connecting line along which the received vibrations may be conveyed to the ultimate seat of the sensorial impressions. Hence we find a lens, a retina, and an optic nerve to be common to all. We may also infer that the external physical requirements will be approximately the same, so that the vibrations must be of proper quality, they must be of sufficient intensity, and they must impinge upon the retina for a sufficient time to enable its sympathetic fibres to respond to and take up the impulses imparted.

The first difficulty which we meet with in approaching the subject is one which does not apply to insects alone, and therefore does not enter exclusively into present considerations.

In the case of human vision the optic angle is so small that each eye sees the same object, indeed confusion is experienced and a double image is perceived unless the optic axes are so converged upon the object as to bring its image upon the correspondingly sympathetic portions of each retina. But in the case of some animals, and in that of birds, the increase of the optic angle precludes the possibility of such co-ordination, so that an entirely dissimilar picture is presented to each eye, and a further complication is introduced in the case of the chameleon, whose eyes are capable of independent movement in every direction within the limitations of their sockets. We are unable to realize in our own minds what the effect of this may be, because, with the exception of impressions received through the sense of touch, we have no analogous experience, but we may readily conceive it to be a matter of interpretation by which the wide extension of the visual field induces the perception of a panoramic view of the surroundings; and if to eyes which are laterally situated we add also others on the vertex, with divergent axes as we find in the ocelli of many insects, we may further imagine that an extension of the panorama vertically may present a picture embracing an area of more than half a hemisphere.

But when we come to regard vision by means of compound eyes, such as we find in insects, other considerations present themselves and it is obvious that the question as to "why and wherefore" requires another answer. I should like to be allowed here to make a protest against the continued application of the term "facetted" to the corneal surface of the compound eye, as conveying an idea which is not strictly correct. At a recent converzatione I found, amongst other objects exhibited, a plano-convex lense, the curved surface of which was ground off into numerous actual facets, and visitors were invited to look through this from its plane face in order to realize the effect produced by the "facetted" eye of an insect. I need not point out that both structurally and optically this conception was entirely erroneous. The structure of the compound eye is, however, now so well known that I do not propose to enter upon it here at any length, but will merely refer to the recent researches of Professor Exner and others as showing (1) that, contrary to previous speculations, it is capable of forming a distinct image of considerable amplitude, towards which each ocellite contributes its share; (2) that in the picture so produced very many of the pictures formed by adjacent ocellites are either superposed or overlap each other in such a way that the corresponding portions of each become coincident upon the retina; and (3) that it is highly probable that the structure of the organ provides an arrangement which serves a purpose equivalent to that of the iris in the vertebrate eye, with the further suggestion of a means of focussing. Professor Exner's experiments also prove that by the intervention of the crystalline cones this composite, or "summation," image is erect, and is formed at an increased distance from the corneal surface.

Those who have access to the last edition of the late Dr. W. B. Carpenter's book, "The Microscope and its Revelations," will have noticed a reference to these researches, but it may be as well to note that the figure on page 908 appears to have been laterally inverted by the engraver, my own recollection and a rough sketch taken at the time enabling me to say that in the original photograph the letter R was not reversed as shown in the wood-cut, and the church faced the other way.

Assuming, therefore, that distinct and otherwise perfect vision is enjoyed by the possessors of compound eyes, it is reasonable to suppose that, if we desire to know what is the *raison d'etre* of their complex structure, we shall be most likely to find the answer, if we proceed upon lines indicated by the further assumption, that it is required to meet some special necessity arising from conditions of life which differ from those of other creatures.

Pursuing the inquiry in this direction the following considerations make it probable that such conditions may be recognized in connection with the extremely rapid movements of insects in flight.

The angular diameter of the field of distinct vision in the human eye (as distinguished from the visual angle) is much smaller than is commonly supposed, experiment shows that it varies with individuals, but, for present purposes of illustration, we will call it 10°. The inconvenience which would otherwise arise from so circumscribed an area is in practice largely compensated for by the celerity and freedom of motion common to the eyes and head, by virtue of which also we are able to neutralize the effect of our own movements, and, within certain limits, to perceive moving objects which would otherwise cross the field in less time than the minimum required for the production of a distinct retinal image. The exact duration of this period is a matter of personal equation, but may usually be taken as about $\frac{1}{10}$ of a second. Now it is a matter of common experience that when travelling in a railway train at the rate of, say, fives miles an hour, we can, with fixed vision, clearly distinguish the flowers growing adjacent to the track, but, as the speed increases, we become less able to do so, until, at 50 miles an hour, they cross the visual area too rapidly to leave more than an indistinct impression of horizontal lines. It is, however, conceivable that if, as soon as an object had traversed the field of one lens, it came successively within the scope of nine others, which, without break of continuity, would project its image upon the same portion of the retina, the persistence of the image would be increased tenfold, with the obvious result that the flowers would then be seen as clearly whilst passing them at 50 miles per hour as they would be under ordinary circumstances at one-tenth the speed.

If there is truth in this suggestion, that the use of compound eyes is to enable their possessors to enjoy distinct vision during rapid flight, it would appear to derive support from the fact that we find, as a rule, that in larvæ and in insects which are wingless the eyes are either simple, or that the ocellites, of which they are compounded, are comparatively few in number; whilst in those with wings the compound character is developed to its highest degree in genera whose powers of flight are most remarkable. Instances are not wanting in which the eyes of apterous females are simple, whereas they are compound in the case of the winged males of the same species.

That such extremely rapid flyers as the dragon-flies and predatory Diptera are endowed with acute and accurate powers of vision seems to require no further proof than is afforded by the unerring manner in which they strike and capture other insects which are also on the wing.

PROFESSOR SOPHUS RUGE of Dresden, an authority on matters relating to the discovery and exploration of America, pronounces Mr. Winsor's "Columbus" "the most important contribution that North America has made to the present commemoration" of 1492.

TURKISH TIME-PIECES.

BY F. A. SEELY, WASHINGTON, D C.

MANY years ago I ventured the opinion that the development of the mechanical clock was hindered for many centuries by the general use of the Roman system of hours. I am more than ever convinced of this. It is perfectly well known that prior to the Christian era trains of gearing and other mechanical expedients were in use whereby the hand of a clock could be made to travel with uniform motion on a dial. There was, to be sure, no true mechanical escapement, but Ctesibius had devised what I venture to call a water escapement, which, under certain restricted conditions, performed the true function of that element of the modern clock. But the ingenuity of the times was not adequate to the production of the varying movement necessary to keep time in a system in which the length of the hours was constantly changing; and so the clock waited many centuries until the system of hours was changed.

This subject has been brought quite forcibly to my mind by coming into the possession of a number of German and Swiss patents for clocks designed to keep Turkish time. It appears from the specifications that the Turkish system of hours is practically identical with that of ancient Rome, the day commencing and ending with sunrise, and the middle being at sunset, the two periods of day and night being divided into six hours each, which constantly vary in length with the change of season.

It is obviously impracticable to make up a railroad time-table on such a system, or to accommodate it to numerous other requirements of modern social life; and therefore the wonder is that anybody should think it worth while to construct a clock adapted to this system; but, as the patentees are in all cases residents of Constantinople, it may be inferred that, in devising these clocks, they are endeavoring to minister to a felt want of that capital.

The device employed is of the same character in all the patents, though in some automatic, in others requiring frequent attention. It consists in so adjusting the governing member (pendulum or balance-wheel) as to give it a faster or slower rate from month to month; that is to say, in the winter months, when the period from sunrise to sunset is short, to quicken the action of the movement so that the hand shall pass in proportionately less time over that portion of the dial which represents the hours of daylight than it does in summer, when the days are long. It is obvious at once that this does not accomplish the purpose sought for, and the inference is natural that in the German and Swiss Patent Offices the question of utility cannot have been raised on these applications. If the pendulum is adjusted to a slow beat in the month of June, when the hours from sunrise to sunset are long, it might measure time during the day, but that same slow beat will destroy its capability of measuring off the short hours of the night. A parallel statement is true for the month of December. For this reason these inventions are useless, though they may serve the purpose of the patentees by imposing on the credulous Moslem.

It does not seem impossible in the present state of the arts to construct a time-piece capable of marking off this kind of hours with reasonable precision. The exactness of an astronomical clock or even of an ordinary kitchen clock would be unnecessary. But the inventions above referred to do not approach a solution of the problem, the key to which is to be found in a clock presented to this Government by that of Japan at the close of the Centennial Exposition. In this the hand moves around the dial at a uniform rate throughout the year, the adjustment for different seasons being accomplished by shifting the figures on the dial. It is many years since I have seen this clock, but, as I recollect it, the top of the dial represents sunrise and the bottom sunset, the half-circumference on each side being divided into five hours by a set of figures which can be shifted in place as the seasons change so as to make the day hours long and the night hours short, and *vice versa*, the sunset hour being shifted also.

I see no great difficulty in producing this shifting of the sunset hour automatically to the right or left as the season may require, nor does it appear to me insurmountable to connect the intermediate hours with the sunset hour so that they shall be shifted proportionately with it. With such a contrivance an hour-hand moving at an equal rate over the dial would point to the true hour by Turkish time at all seasons of the year, day and night. In fact, the problem seems to me so easy of solution that I can only explain the non-appearance of such clocks in the market by the supposition that no actual demand exists for them.

NOTES UPON THE ACTION OF DRUGS AND AGENCIES UPON THE RESPIRATORY MOVEMENTS.

BY HORATIO C. WOOD, M.D., LL D. (YALE), UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

THE results of a research which I have recently completed in the laboratories of the University of Pennsylvania, although bearing very directly upon practical medicine, have, I think, sufficient scientific interest to be noted in the columns of *Science*.

Hitherto, the study of the action of agencies and drugs upon respiration has been made chiefly, if not solely, by noticing their effects upon the rate of respiratory movements. It is evident, however that increased activity of rate does not necessarily imply increased activity of function, since the respirations, though more frequently repeated, may be so shallow as to have little effect. Aided by Dr. David Cerna, now of the University of Texas, I have measured the amount of air taken in and out of the lungs of the dog under different conditions.

Emotional or nervous excitement was found to be a most potent agency; the dog seemingly expressing his feelings in his respiration as completely as a human being expresses his in his face; so that during excitement more than twice as much air is moved as during quiet. It has long been known that the dog, having practically no sweat-glands, cools himself through the respiration; and so it was found that heating the animal, by such arrangement of apparatus as not to cause pain, nor to bring hot air in contact with the lungs, nearly doubled the respiratory movement of air. Heat, therefore, is to the dog a powerful respiratory stimulant; when in excess, however, it depresses function, as it was found that if the heating were continued the air movement became almost null. The rapid respiration seen in human beings suffering from fever, indicates that they are affected by heat similarly to the dog.

Chloral was found to be a more positive, persistent, and certain respiratory depressant than the morphine salts; it always reduced the air movement, and the reduction, with repeated and increasing doses of chloral, was progressive, until finally respiration was completely arrested.

The actions of atropine, cocaine, and strychnine were studied both in the normal and in the chloralized dog. Each of these alkaloids was found to be a powerful respiratory stimulant, increasing most markedly the air movement. The rather unexpected result was reached that cocaine is probably the most powerful of the three, but that strychnine is the most persistent and certain in its action. Thus, whilst cocaine seemed to be almost powerless against overwhelming doses of chloral, the influence of strychnine never failed to be manifested.

The bearing of this research upon practical medicine is very evident. During the experimental preparation for my address before the Berlin Medical Congress in 1890, I discovered the great power of strychnine over the respiratory centres when almost completely paralyzed by chloroform or ether; a discovery which led to the universal practical use of strychnine in the treatment of the accidents of anæsthesia. Atropine has long been used in narcotic poisoning, but its value as a respiratory stimulant within the last year or two has been very seriously challenged. Our research, however, re-demonstrated its power as a respiratory stimulant. Cocaine has been used to some extent as a respiratory stimulant, but it seems to be much more efficacious than is generally thought. It was found in our research that in the deeply chloralized dog, after respiration had been brought up as far as possible by one respiratory stimulant, the second stimulant was able to still further increase the extent and power of the respiratory movements. I have apparently saved human life in respiratory failure, by adding cocaine to the strychnine which was being given in as large dose as was thought justifiable. Cocaine

and strychnine, however, have so much similarity of action upon the spinal cord that the use of one of them would probably somewhat increase any danger that may have been incurred by the administration of large doses of the other.

On the other hand, atropine has little influence upon the spinal cord, its general physiological action being quite distinct from that of cocaine or strychnine. It is therefore probable that by the consentaneous use of atropine and strychnine, or of atropine and cocaine, the physician may obtain the advantage of what, many years ago, I spoke of as the "crossed action" of drugs; the two drugs touching and reinforcing one another in their influence upon the respiratory functions, and spreading wide apart from each other in their unwished for and deletereous effects.

In conclusion, for the sake of any one who may be interested in the details of this research, it may be stated that it will shortly be published in full in the English *Journal of Physiology.*

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Man and the Glacial Period.

A MISLEADING paragraph in Dr. Brinton's otherwise excellent review of a recent publication under the above caption,[1] in connection with the Reverend Professor Wright's response,[2] seems to demand a further word. Dr. Brinton errs in saying "As a glacialist, the author of this volume stands among the first in the country, and his long study of that remarkable period in the geologic history of our planet invests everything he says about it with uncommon authority."

Within recent years there has grown up a new branch of geologic science, which has been called by its devotees "geomorphic geology," "geomorphology," and still more acceptably "geomorphy," and which is frequently spoken of as the "New Geology." It is the function of geomorphy to read geologic history from earth-forms, as the older geology read history from deposits and their fossils. Beginning a score of years ago with Powell's conception of the "base-level," at which erosion ceases, the primary idea has extended and expanded until now the geologist not only recognizes ancient base-levels in certain topographic forms, but is able to determine from steepness of slopes and other topographic relations the rate at which erosion has proceeded in the past, and thereby the attitude and altitude of the land during earlier ages. This branch of science has been successfully pursued by a number of geologists in this country and a few abroad, and is taught in three or four universities; and it has been found of especial use in the study of glacial deposits It is, however, a sealed book to Professor Wright; not a syllable in his latest work, or in any other of his many publications, or in his public utterances before scientific societies, suggests that he is aware of the existence of the New Geology.

Within two decades the discriminating genius of Chamberlin and a score of fellow-workers in this country has thrown much light on the events and episodes of the glacial period. Largely through the application of geomorphy, it has been shown that the glacial deposits of north-eastern America represent two, three, or more distinct ice invasions occurring at different epochs in a long period, and that the earliest of these deposits is many times older than the latest — indeed the leading authorities agree that if the post-glacial period be represented by unity, then the entire glacial period must be represented by two figures. This succession of ice deposits and ice invasions is not, indeed, recognized by some of those glacialists whose observations have been confined to regions in which only a single deposit is represented; but with one or two exceptions (including our author's namesake, A. A. Wright, professor of geology at Oberlin) every geologist who has studied the marginal drift holds to the bipartite or tripartite or multipartite character of glacial deposits and glacial history. This succession is not admitted by the Reverend Professor Wright. Accordingly, his ideas concerning early man have no definite time-basis and cannot be discussed intelligently by modern archæologists — it would be as easy to discuss the opinions of an author who confounded not only all the successive dynasties recorded in the monuments and hieroglyphs of Egypt but also the works of the modern fellahin, or of a genealogist who argued that the families of a dozen successive generations dined together at the same board. As an exposition of the antiquity of man and the glacial theory, "Man and the Glacial Period" is a cry from the tombs of a dead past; it represents the primitive knowledge of a quarter-century ago, and might then have been considered authoritative; but its publication to-day is an offense to science.

Professor Wright objects to Dr. Brinton's "flippant treatment" of the Nampa figurine, and insists that a geologist who happened to detect the fraud on the ground should burden scientific literature with some detailed statement. It does not seem to occur to him that the gentleman in question avoided rushing into print simply because the fraud was too transparent to deceive geologists, who alone are competent to deal with questions concerning the geologic antiquity of man. Respectable and cultured gentlemen seem indeed to have been deceived by this alleged "find," — but they were not geologists; so, too, respectable and cultured people, including an illustrious naturalist, have been deluded by a Philadelphia adventurer with an alleged motor,— but no physicist was deceived; in like manner, intelligent and honest people have been deluded by a brazen pretender into the belief that the heavens may be frightened into tears by cannonading — but the meteorologists are not deluded; and the circle-squares and perpetual-motion inventors are abroad in the land, yet the mathematicians and the mechanicians are not deceived. And it would be folly for the physicist, the meteorologist, the mathematician, and the mechanician to rush into print and advertise each new fraud, for thereby the press would be flooded and libraries crowded, while fraud would only flourish the more for the advertising. So long as poor human nature remains as it is, the knave and the dupe we shall always have with us; and it is to be regretted that a presumably competent authority in his own specialty of theology should be willing to assume either *rôle* in another line of activity.

The author of the work has indeed visited many existing glaciers, and his observations would be of value to geologists if they could be accepted with confidence. A case in point is his measurement of the rate of flow in Muir glacier, in which he employed primitive methods and recorded a result so extraordinary as to challenge credulity. Subsequently, the measurement was repeated by Professor Reid by a superior method, with a widely different result which is in harmony with all other observations. Instead of acknowledging his evident blunder, or even passing over the matter in silence, Professor Wright has the assurance to "talk round" the issue (p. 47), and thereby impugns the excellent work of a later observer.

"Man and the Glacial Period" is published by a reputable house as one of an "International Scientific Series," and thereby acquires a respectability to which otherwise it could not aspire. Dr. Brinton has fairly, albeit charitably, shown its weakness from the standpoint of anthropology; other reviewers have shown that it sinks even lower when viewed from the standpoint of geology.[3] In other ways, too, the title-page conveys erroneous impressions as to the profession and standing of the author. Thus, he takes unto himself the title "Assistant on the United States Geological Survey." The facts are, that he was temporarily employed by one of the collaborators of the bureau largely for the purpose of testing his competence as an observer; and that the test resulted unsatisfactorily to the bureau and was brought to an end several years ago.

In brief, the world would be wiser if the book were not written.

W. J. McGEE.

Washington, D.C.

[1] Science, vol. xx., 1892, p. 249.

[2] Op. cit., pp. 275-277.

[3] E.g., Professor T. C. Chamberlin in The Dial, Vol. XIII., pp. 303-306, November 16, 1892.

Pseudaurora Borealis; or, What was It?

THE observations which I am about to recount may not be new to others, but, as I have failed to see or hear of any such after several years' waiting, I communicate mine, hoping that by doing so I may call them out if there are any. The business portions of Minneapolis, Minn., had for many years been lighted by the Brush system of electricity, during which time that method of street illumination had been extended considerably in all directions, leaving, however, much more that continued to be lighted by gas and oil. I had occasion to visit the suburbs of the city under circumstances which delayed my return until a very late hour, and for a considerable portion of my way the latter method of lighting prevailed. On passing into the electrically-lighted section, my attention was arrested by the appearance of the aurora borealis, or northern lights.

It being in the month of February, and their appearance at that season by no means a rare event, while the lateness of the hour, and the severity of the cold, with the air so filled with frost as to give an appearance of a light fog, I was hastening forward as rapidly as I could on foot, when I noticed that the aurora had disappeared, but after a few steps more it reappeared. Pausing a moment, I saw there was no mistaking the fact of my seeing a genuine display of northern lights, I again went forward with the same experience of interruption. This circumstance awakened a suspicion that the phenomena were in some way to be accounted for by the presence of the electric lights, and, after another brief pause to make myself assured of the certainty of my observations, I went back along the way I had come until fully out of the zone of the Brush lights, and well into that of the gas-lamps, where I found no signs of an aurora.

Returning slowly towards and into the former illumination, all of the observations were repeated precisely as at first, until having passed a given burner, when the phenomena again ceased. After repeatedly changing my position in relation to a special burner in a northern and southern direction, during which I discovered that the phenomena was most distinct when I was observing them at or about the angle of 60° to the burner, a corresponding movement east and west gave no more facts, and after once more noting the characteristic movements of the serrated columns of partially prismatic radiations of the auroral beams along the penumbrated arc, I went on my way resolved to keep a good outlook for another such observation, but it has never come after nearly five years of waiting. If others have noticed the same, or similar phenomena, it will be gratifying, and in order, for them to say so.

P. L. NATCH, M.D.

Anacortes, Washington, Nov. 3.

The Humming-Bird's Food.

FOR three years I have made a special study of the habits of the yellow-bellied, or sap-sucking woodpecker (*Sphyrapicus varius*), as found in the White Mountains of New Hampshire. The birds arrive in that region near the middle or 20th of April, and remain until about the middle of October. During the whole of this period they derive the more important part of their food-supply from sap-yielding holes which they drill through the bark of red maples, red oaks, poplars, white and gray birches, the white ash and some other trees and shrubs. In every instance where I have found a well-marked drinking-place established by the sap-suckers, humming-birds have been regular attendants upon it during the summer months.

I have paid hundreds of visits to these "orchards" of the sap-suckers, and have watched them for many hours at a time. By so doing I have ascertained that, as a rule, one individual humming-bird seems to acquire a sort of easement in the sap-fountains of the woodpeckers, and if another ruby-throat attempts to drink sap at his spring, violent resistance is offered.

The humming birds, at "orchards" where they are not molested by the woodpeckers, drink scores of times in the course of the long summer day. When not drinking they are usually perched on twigs a few yards from the holes, keeping their nervous heads wagging from side to side while watching for intruders. In a few instances I have seen humming-birds perch upon the bark below the holes in order to drink long without being forced to keep their wings moving while enjoying the sweet sap.

In some cases I have placed small birch-bark cups upon trees frequented by the sap-suckers and their guests, and in each such instance the humming-birds have been as quick as the woodpeckers to discover the diluted maple syrup with which the cups were filled, and to drink it in considerable quantities. I remember seeing one drink for sixty seconds, with a ten seconds' rest in the middle of the minute.

Most of the "orchards" at which I have seen humming-birds as visitors from year to year have been composed of red maples or gray birches. At one of the birch orchards I shot two humming-birds, a male and a female, in order to ascertain whether more of their kind were visiting the holes. Only nine minutes elapsed before another was at the holes drinking.

FRANK BOLLES.

Cambridge, Nov. 28.

Sense of Direction.

SOME time in the fifties, in Oregon, a party of prospectors took a mule team, wagon, and camping equipage on a prospecting tour. In order to be correct in their local geography, and to retrace their steps should they find anything worthy of a re-visit, they took a civil engineer along, who took the bearing of every course and the distance was chained.

When they gave up the prospecting enterprise, their route had been so tortuous that they decided to take the direct route for the home camp. The engineer footed up the latitudes and departures of the courses run, and made a calculation of the course home, and all struck for the home camp. When they reached the end of their course, night had overtaken them, and they found themselves, not in the home camp, but in the woods, with no objects or land-marks that any of the party could recognize.

As the engineer took no "back-sights," or check bearings, he said that local attraction somewhere in their journey had thrown him off a little and that they were in the neighborhood of the home camp. At this, the driver turned one of his mules loose, which went directly to the camp, about three-quarters of a mile distant. As the mules were not allowed to run at large, for fear of wandering off or being stolen by Indians, this mule had never before been over that route, and must have had a sense of direction. It was a joke on the engineer which he did not relish, though it had great "staying qualities."

JOHN T. CAMPBELL.

Rockville, Ind., Nov. 14.

Electrical Phenomena on the Mountains of Colorado.

IN *Science* for Sept. 23, Mr. O. C. Chariton describes a mountain experience, and inquires if it is common or dangerous.

The peculiar buzzing and crackling sound, the standing of the hair on end, etc., are extremely common on the mountains of Colorado. The prospectors, miners, and drivers of pack trains to the high mines (above 11,000 feet) live in the midst of these electrical phenomena, and often find much amusement in observing their effect on the average "tenderfoot," especially when lady tourists, as not seldom happens, find their long hair slip from the fastenings and stand up like the fabled head-dress of the Furies. I have repeatedly heard the sounds at elevations between 6,000 and 7,000 feet, but they are much more noticeable at higher elevations, where they are sometimes terrific. They sometimes mark the tension of the air just preceding a discharge of lightning, but in general they are harmless. I have many times noticed them proceeding with hardly any interruption while the lightning was leaping from cloud to cloud overhead. They are caused by the passage of an electrified cloud, and the effect is rather worse when one is in the midst of the cloud. On these mountains the manifestation of intense electrical phenomena is seldom seen except when there is hail or pellet snow, or the most violent summer showers; and the latter usually have hail in some part of the storm. The loudest buzzings I have ever heard came while a

hail-storm was approaching and while the peculiar shelf or cornice which projects from the base of the storm-mass was in the zenith. This shelf has a flattish and rather smooth surface on its under side and when seen from a distance appears to consist of a mass of cloud having an under-pavement of low domes or flattish billows, and the broader and more peaceful it looks, the worse is the wrath of the storm above and within it. Lightning seldom comes from it, yet it is in a state of intense electrical excitement. While it is passing, there is a loud hissing from stretched wires (not connected with the earth), a stream of sparks, and at night a glow like St. Elmo's fire. A herd of cattle can sometimes be seen in the darkest night by their own light.

The fact is, the physiolgical effects of electric induction are so common in the higher mountains, and are often so ludicrous, that we are in danger of throwing aside these phenomena as of no special scientific interest. Yet we here have a complex problem involving not only the electrified clouds and the air as dielectric, but also the electrical properties of the ground itself. Now many of the prospectors for metalliferous veins declare that the behavior of lightning on veins containing certain kinds of ores differs from the ordinary. Some of them profess to be able to know the nature of the minerals in a mountain by observing the buzzing and other phenomena on the passage of electric clouds, but it is difficult to get them to talk about it, as they appear to regard the matter as a trade secret. Even experienced prospectors leave a certain peak on the approach of severe thunder storms, they declaring their sensations of shock to be unendurable, even when the lightning does not strike the mountain. They report that stones are loosened from the cliffs and fall in dangerous fusilades down the mountain side. No doubt these are in part land-slides, but some of them are reported to take place when no rain fell, only snow or hail, or before the rain reached the place. My informants used this language: "The mountain split and threw off those rocks." I have been desirous of determining the truth of these matters by personal observation, but thus far have not found the opportunity. It is at least a supposable case that electric attraction or repulsion dislodges blocks already loosened. Have any of your readers made observations on these matters pertaining to the effects of different kinds of rocks or minerals on electric clouds, or vice versa?

Perhaps a nearly related problem is furnished by the causes (electrical or otherwise) of the restlessness and often sleeplessness and oppressed breathing that accompanies the warm westerly or Chinook winds over the mountains. GEO. H. STONE.

Colorado Springs, Oct. 24.

The Gila Monster.

THERE has been considerable discussion as to the poisonous character of this lizard, and of late it seems to be accepted that it is not poisonous by the scientific people from the fact that the animal has no poison-sack or fangs, this does not by any means settle the question, for many of us know by personal experience that it is poisonous, and very much so at times. There are several people almost every year in Arizona and elsewhere who either lose their lives by it or suffer intolerable agony from it, and the notion that it is not poisonous does not lessen the number of sufferers. If the animal is in its normal condition and bites a person, no harm usually comes from it. It is a very pugnacious animal and is easily excited to frenzy, and especially so when it is being captured alive; at such times it emits a yellow and very rank-smelling saliva, which, if it enters the circulation by a wound or otherwise, produces death or great suffering in human beings. One case that came under my observation was that of a young man, in Arizona, who was bitten under those circumstances and who was sick for several months and had the disintegration of the blood and the effusion of serum that so frequently occur in those suffering from a rattlesnake's bite. I have no doubt that this explanation accounts for the poisoning of people by other "non-poisonous" lizards of our arid region. I should not be at all surprised to hear that even the horned toad that the boys so delight to torment is also poisonous under such circumstances.

MARCUS E. JONES.

Salt Lake City, Nov. 10.

Grand-Gulf Formation.

I AM glad to see that Judge Johnson accepts my determination of the brackish water character of the fauna of his Pascagoula clays, as it is a matter of some importance in the genesis of the tertiary strata of the Gulf border; and I am not disposed to quarrel with him if he chooses to retain the term "formation" for them provided it is made clear exactly what he understands by that term. His original communication was somewhat obscure on both these points and by placing a species of *Venus* in the bed (which is a strictly marine genus) I was led to suppose that he regarded the bed as (not deep sea but) purely of salt water origin.

In saying that I have permitted "conjecture" "to outrun and forestall positive discovery" in my brochure of January last, Judge Johnson simply indicates that he is not aware of the material in my possession and which though published (for the most part) during the last ten days, has been nearly two years in manuscript awaiting the printer's opportunity.

My short paper on the Pliocene of the Carolinas gave merely a tabular view of the results to which seven years of field-work and study of the material collected by numerous other workers in the field had led me. This may be found substantiated in Bulletin 84 of the Geological Survey just printed, but the portion relating to Florida had been type-written for the use of Messrs. Eldridge and Jussen before they entered upon their field-work, and it is, therefore, not exact to state that the differences between the older and the newer Miocene were "established" by those gentlemen, who had the essential solution of this question in their hands to begin with, Mr. Jussen having devoted under my direction some time to the study of the Old Miocene fauna of the Chipola beds before he entered the field at all.

Hasty generalization and hasty writing of all sorts are "baneful" I willingly admit, and an excellent example of what is to be avoided by lack of haste is shown by Judge Johnson himself in the letter alluded to (p. 247).

I have nowhere asserted that the Pascagoula clays are of Chesapeake age. As a matter of fact, they have nearly the whole of the Grand Gulf series between them and the Chesapeake formation. Judge Johnson's Waldo formation comprised beds belonging to two different epochs, the typical locality at Waldo, from his own specimens, being Chesapeake, and other localities mentioned by him, in his definition of the formation, are Old Miocene. I do not know what he refers to by the expression "overlying clays" at Aspalâga on the Appalachicola River, and certainly have never "shown" them to "be Chesapeake." Aspalâga lies in the region of the oldest Old Miocene, the fossils which I have seen from there are those solely of the Chattahoochee group. On the other hand, the Miocene discovered by Johnson at De Funiak Springs and eastward to Abe's Springs on the Chipola River is not the Older Miocene but the Chesapeake, with a typical Chesapeake fauna so far as yet developed. Still further, the Chattahoochee beds of Langdon distinctly underlie the Chipola beds, so far as they have yet been identified, and the fauna, while related to that of Chipola proper, is not the same.

In short, the Miocene limestones of Florida are so closely similar that the only way of identifying them (short of continuously tracing the beds, which is for the most part impracticable in Florida) is by their fossil contents, which can only be adequately studied in what Judge Johnson calls the "closet," that is to say, a museum supplied with the literature and specimens for comparison.

As the Grand Gulf lies probably above both the Older and the Chesapeake Miocene, I fail to see how the water-bearing sands at its base can serve to discriminate or define the distinction between the two older formations. Some part of the Grand Gulf is very likely contemporaneous with part of the later Miocene, but as yet information is absolutely deficient on this point. What we have called the "upper bed" at Alum Bluff, or the "Ecphora bed" of my Bulletin 84, is typical Chesapeake Miocene, identical with that at Waldo so far as its fossils are concerned. Lithologically, the beds are quite different. As for the Hawthorne and Ocheesee beds, both contain fossils, and we have fossils from the former collected by Judge Johnson himself. For details, the enquiring reader is referred to Bulletin 84, above mentioned.

Finally, in regard to Judge Johnson's "outline of the evolution of the Florida Peninsula," I confess to being ignorant of its existence either in print or otherwise, until long after my own views had not only been verbally communicated to many members of the U. S. Geological Survey and presented to the Biological Society of Washington, but had been circulated in type-written copies for the use of Mr. Eldridge's field-party. It is proper to say that while I had for some time entertained the theoretical view of the insulation of the Eocene island of Florida, the final proof was supplied by the field observations of Mr. T. W. Stanton of the U. S. Geological Survey, while the exploration of the Chipola beds, for material by which their age was determined, and the discovery of their existence in the typical locality on the Chipola River were first made by Mr. Frank Burns of the U. S. Geological Survey; though Langdon had previously observed the lower bed at Alum Bluff, which proves to be of the same age.

WM. H. DALL.

Smithsonian Institution, Oct. 31.

BOOK-REVIEWS.

A Course on Zoölogy. Designed for Secondary Education. By MONTMAHON and BEAUREGARD. Translated from the French by WM. H. GREEN. Phila., J. B. Lippincott Co. 75 cts.

THE introductory books of science of Paul Bert for use in the lower schools are very well known in this country, and have been of very great value in introducing science into the lower grades of education. The above course of zoölogy by Montmahon and Beauregard is designed as a second book in the same series, and is planned to give to a higher grade of students a somewhat extensive study in zoölogy. The translation of this book into English will be of great value to many of our high schools where an elementary text-book in zoölogy is desired and one interesting to students. The plan of the book is the natural method of proceeding from the known to the unknown. It begins with an outline of the study of human anatomy and physiology, and passes from this subject to the study of the dog, the chicken, the lizard, the frog, the fish, and then to the invertebrates, beginning naturally with insects and crustacea and then passing through the lower orders of invertebrates somewhat more hurriedly. After having thus given a general study of a type illustrative of each of the large groups of animals, the last half of the book is occupied with a popular study of the larger and better known animals, chiefly mammals and birds. This part of the book is very abundantly illustrated with figures of the animals mentioned and described, and throughout the illustrations are abundant and good. For the purpose designed this book is open to the criticism that it attempts to crowd rather too much detailed information and too many scientific terms into a short compass. But, on the whole, the style is simple, easily understood by the student for whom the book is designed, and the book seems to be admirably adapted for exciting an interest in zoölogical subjects among students of the secondary grade of schools. The scholar will hardly get a systematic knowledge of zoölogy out of the book, but this could not be expected of any zoölogy adapted to the secondary schools. The work can hardly fail to excite an interest, however, in the scholar and lead him to using his own eyes in the observation of nature, which is, of course, the chief design of scientific instruction in the lower schools. This book can thus certainly be recommended for introduction into high schools and even into schools of lower grade.

Chemical Theory for Beginners. By LEONARD DOBBIN and JAMES WALKER. New York, Macmillan & Co. 8°. 248 p. 70 cents.

THE study of chemical theories should be based upon a wide range of experimental facts; and the title of this little volume is unpromising. The theories, however, are supported by numerous experiments. The beginner may find some things hard to understand, but much that is profitable. Those who are familiar with

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Nov. 26.—F. L. O. Wadsworth, Method of Determination of the Metre in Terms of a Wave Length of Light; B. E. Fernow, Recent Contributions Towards the Discussion of Forest Influences; R. T. Hill, The Occurrence of Iron in Mexico.

New York Academy of Sciences, Biological Section.

Nov. 14. — The papers were: Arthur Hollick, On Additions to the Palæobotany of Staten Island. About forty species were presented, of which half had been already described from Greenland Cretaceous and from the Laramie. The fossils, leaf-fragments, fruits, and seeds, occur in fire-brick clay, or in ferruginous sandstone or concretions. The genera notably represented were Populus, Platanus, Myrica, Kalmia, Acer, and Williamsonia. H. F. Osborn, Report upon a Collection of Mammals from the Cretaceous (Laramie). The multituberculates, Meniscoëssus and Ptilodus, were assigned to the Plagiaulacidæ, the former a probable ancestor of Polymastodon. The relations of these mammals were shown to be closer to Puerco than to Upper Jurassic forms. Arthur Willey, On the Significance of the Pituitary Body, and made the suggestion, founded on researches on the Ascidians and Amphioxus, that, if the Amphirhinic condition of the higher vertebrates was preceded by a Monorhinic condition, the nose in the latter case was not represented by the small nasal sac of Petromyzon, of which the unpaired character is undoubtedly secondary, as shown both by its development (Dohrn) and by its nerve-supply; but the nose in the Monorhinic ancestor of the Vertebrates was the organ which we know as the Pituitary Body or Hypophysis cerebri in all existing Vertebrates, this being represented in the Ascidians, as shown by Julin, by the subneural gland and its duct, and in Amphioxus by the so-called olfactory pit. The Pituitary Body is to the lateral Nares what the Pineal Body is to the lateral Eyes. Bashford Dean exhibited an entire Cladodus, a unique specimen recently collected in the Cleveland Shales. The tail, for the first time shown, indicates historically the origin of this part in modern elasmobranches.

Publications Received at Editor's Office.

ADDISON, STEELE AND BUDGELL. Sir Roger de Coverley Papers. English Classics for Schools. New York, American Book Co. 148 p. 12°. 20 cents.

ALLSOP, F. C. Practical Electric-Light Fitting. New York, Macmillan & Co. 275 p. 12°. $1.50.

BABET. 99 Methods of Utilizing Boiled Beef. Tr. from the French. New York, John Ireland. 122 p. 8°. 75 cents.

BARKER, A. S. Deep-Sea Sounding. New York, Wiley. 133 p. Maps. 8°. $2.

BARKER, GEO. F. Physics; Advanced Course. Second Edition. New York, Holt. 902 p. 8°.

CAMPBELL, H J. Elementary Biology. London and New York, Macmillan & Co. 284 p. 12°. $1.60.

CONTRIBUTIONS from the Botanical Laboratory of the University of Pennsylvania. Vol. I., No. 1. Philadelphia, University of Pa. 72 p., pl. 8°.

DINGLE, EDWARD. A study of Longitude. Plymouth, Eng., Geo. H. Sellick. 24 p. 8°. 1s.

GALTON, FRANCIS. Finger Prints. London and New York, Macmillan & Co. 216 p. 8°. $2.

HOSKINS, L. M. Elements of Graphic Statics. London and New York, Macmillan & Co. 191 p., pl. 8°. $2.25.

IRVING, WASHINGTON. Ten Selections from the Sketch-Book. English Classics for Schools. New York, American Book Co. 149 p. 12°. 20c.

MCLENNAN, EVAN. Cosmical Evolution. Chicago, Donohue, Henneberry & Co., 1890. 399 p. 8°.

SCOTT, SIR WALTER. Ivanhoe. English Classics for Schools. New York, American Book Co. 484 p. 12°. 50 cents.

SHAKESPEARE, WM. Julius Cæsar. Engli[illegible] sics for Schools. New York, Ameri[illegible] Co. 114 p. 12°. 20 cents.

the usual phenomena of chemical action may peruse the work with still more profit. The topics are introduced methodically, beginning with units, states of aggregation, elements and compounds, and conditions of chemical action; but proceeding to the more difficult laws, and giving due notice to such topics as kinetic molecular theory, mass action, dissociation, solution, electrolysis, and the periodic law. Chemical students whose attention has been concentrated on the facts observed in experiment will find these theories very suggestive.

An Introduction to Chemical Theory. By ALEXANDER SCOTT. London and Edinburgh, Adam & Charles Black. 8°. 274 p. $1.25.

THIS volume presents modern views and much valuable information upon the constitution of matter, atomic and molecular weights, classification of elements and compounds, vapor densities, and other physical properties, thermo-chemistry, chemical change, solution, and electrolysis. It claims to be an *introduction* only, although a fair knowledge of chemical facts and experiments is assumed; and it would be unreasonable to expect such completeness as in the works of Ostwald, Meyer, and Naumann. It may prove attractive to many who would be repelled by the more comprehensive works; or, better still, it may awaken a thirst for such exactness of scientific statement as requires more mathematics than Dr. Scott admits into his elementary volume.

AMONG THE PUBLISHERS.

"THE Eighteenth Report of the Geological Survey of Indiana: Palæontology," by S. A. Miller, contains descriptions of a large number of new fossils from various formations, mainly of Upper Silurian and Sub-Carboniferous age. Crinoidea largely predominate, no less than 89 new species and 4 new genera being described. It is unfortunate that some of the species are described from single specimens. All are, however, illustrated. Mr. Miller pays his compliments in his usual way to Professor James Hall and Professor Hyatt. Some of the new species are from the Cincinnati, or Hudson River, group of south-eastern Indiana.

— *St. Nicholas* is universally considered "the best of children's magazines." Contributors for 1893 include John G. Whittier, Edmund C. Stedman, Frank R. Stockton, George W. Cable, Frances Hodgson Burnett, Thos. Wentworth Higginson, George Kennan, Charles Howard Shinn, Laura E. Richards, W. O. Stoddard, Harriet Prescott Spofford, Susan Coolidge, Mary Hallock Foote Kirk Munroe, Hezekiah Butterworth, President Gilman, Rev. Dr. Lyman Abbott, Howard Pyle, Colonel R. M. Johnston, John Burroughs, H. H. Boyesen, Nora Perry, Poultney Bigelow, Charles F. Lummis, Edith M. Thomas, Kate Douglas Wiggin, and Mary Mapes Dodge.

— Following the principles announced by Teisserenc de Bort, G. Raymond has prepared a little brochure (Paris, Gauthier-Villars) concerning the influence of the chief centres of atmospheric pressure on the prediction of the weather. De Bort laid down his general plan some years ago, and Raymond now presents a number of specific examples that seem to follow in accordance with it; illustrating the conditions for mild winters, moist summers, and so on. The book deserves study by those who have access to our International weather bulletins, and who can undertake the difficult task of generalizing their innumerable facts.

— Henry Collins has written an interesting little pamphlet on "The International Date Line" (Bardeen, Syracuse, 15 cents), giving a chart of the line that runs irregularly through the Pacific, and on either side of which the dates differ by a day. Teachers will find it instructive; although a few matters of fact might have been more fully ascertained before publication, as by correspondence with consuls. The interesting point is raised: Who first celebrate the New Year? It is clearly shown that the 180° meridian from Greenwich has not the importance often given it in the matter of changing dates.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A new Model U. S. Army Hospital Microscope (Zentmayer), also ½-inch and 1½-inch Objectives. HENRY C. WELLS, 151 Broadway, New York.

For sale or exchange.—A Stevens' new model pocket shot-gun, 44 cal., with 22-cal. rifle barrel. Just the thing for collecting birds and small mammals. Will exchange for a 22-cal. cane-gun or good books on ornithology. Write for particulars, stating what you have for exchange. R. C. McGREGOR, 2841 Champa st., Denver, Col.

For sale.—A very fine stone sword (?) so named by myself. It is perfect—15 inches in length, a little over 2 inches in width, and ½ inch thick. It is of a dark slate color, perhaps limestone, and is the largest implement of the kind known. Some fifteen years ago, when it was not mine, I was offered $40 for it; since that time it has come into my possession; that price will now buy it. Address Rev. C. FOSTER WILLIAMS, Ashwood, Tenn.

For exchange.—Fine specimens of Wis. fresh-water pearls. I want books or papers on marine and fresh-water algæ; also classified specimens of same. I will exchange for Smithsonian reports or crystallized minerals. D. M. ANDREWS, Dodge Centre, Minn.

For Sale or Exchange.—The undersigned has a lot of first-class duplicate bird's skins and sets of eggs, both rare and common, for sale or acceptable exchange. Also about two hundred second class skins and five hundred eggs, suitable for study specimens, at very low figures. The latter, for starting a collection, are as good as the best, embracing all classes and nearly all families. Also about forty species of fossils, principally Devonian. MORRIS GIBBS, M.D., Kalamazoo, Mich.

Wants.

A POSITION is desired in the South, preferably the Gulf States, where I can teach the sciences. Can also instruct in other branches. Salary only nominal, as I am simply desirous of employment while spending the winter in the South. A private family preferred, but will accept regular school work if not too confining. MORRIS GIBBS, M.D., Kalamazoo, Mich.

WANTED.—By well-qualified and experienced science master and associate of the Royal School of Mines, London, aged 26 (at present in England), a mastership in technical college or university for any of the following subjects: Engineering sciences, geology and mineralogy, physics, chemistry and metallurgy, etc., etc. Can provide excellent references and credentials. Apply, J. G., 17 Sussex St., Rochdale, England.

METALLURGICAL CHEMIST will give instruction in the metallurgy and chemical analysis of iron and steel. Complete or special courses applying to the manufacture of pig irons and steels, as well as to their uses. Address "METALLURGIST," care SCIENCE.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems, fossils, shells, archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Hortter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.

CHEMIST AND ENGINEER, graduate German Polytechnic, Organic and Analytical, desires a position in laboratory or chemical works. Address 213½ E. 7th Street, New York, care Levy.

TO THOSE INTERESTED IN SCIENCE.

[Science (weekly) established in 1883, N. D. C. HODGES, 874 Broadway, New York City.]

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Bird on Its Nest, The.
Birds Breeding at Hanover, N. H.
Botanical Laboratory, A.
Botanists, American and Nomenclature.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diamonds in Meteorites.
Diphtheria, Tox-Albumin.
Dynamics, Fundamental Hypotheses of.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
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Iowa Academy of Sciences.
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SCIENCE

NEW YORK, DECEMBER 9, 1892.

BRILLIANT AURORÆ OF 1892.

BY LEWIS SWIFT, ROCHESTER, N. Y.

THE months of June and July of the current year will long be remembered as having afforded three interesting auroral displays, one of them being of unrivalled splendor and intensity. Of all the newspaper descriptions of them which I have read, not one

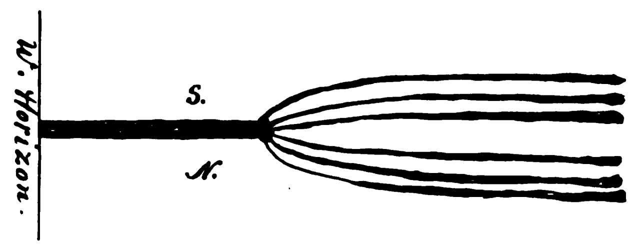

FIG. 1.

portrays them as seen from the flat roof of the Warner Observatory with an unobstructed horizon. Two of these exhibitions I consider unique if not unexampled.

On the evening of June 16, just before midnight, turning my eye from the telescope, a bright narrow beam of light was seen extending from the western horizon to an elevation of some 50°, at right angles to the magnetic meridian, and, of course, parallel with its equator. Here it divided into six parallel bands or branches, like six gigantic fingers of an outstretched hand, which continued to 5° beyond Alpha Cygni, or to a length of more than 60°, when they all sharply ended (Fig. 1). After a visibility of about twenty minutes it slowly disappeared, and was the only sign of aurora observed during that entire night.

Again, at early twilight on the evening of July 16, a portion of a faint auroral band some 15° in length was observed just south of Alpha Aquilla, having on the south side two, and on the north,

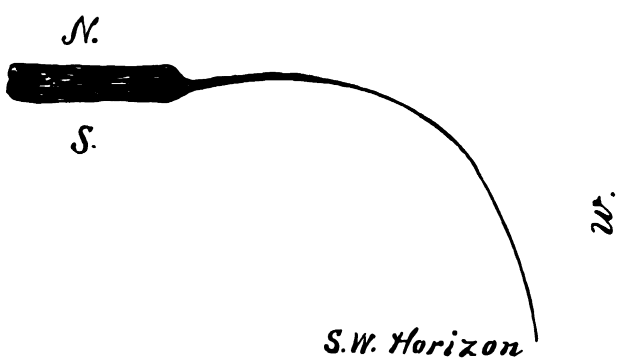

FIG. 2.

one short, narrow band close to, though not touching, the principal one. This, being so far south, was of itself an uncommon occurrence, and, as twilight deepened into night, a slender stem not exceeding 15° in width issued from the western end and gradually lengthened, curving to the south-west and south until, like a mighty sickle, the band serving for a handle and the curved ray for its cutting blade, it reached nearly to the south-western horizon (Fig. 2). It lasted about a half-hour, growing brighter and longer as twilight increased, when it quite suddenly disappeared. Immediately after, a rosy cloud and tinted streamers appeared in the north west, and the grandest auroral display of the century commenced.

During thirty five years of out-door night work I have never seen any auroral phenomena at all resembling these two instances, and would much like to know if these appearances were witnessed by other observers elsewhere

A perfect auroral exhibition consists of at least ten distinct phenomena. It is very seldom, however, that all or even a majority of the requisites are present at any one display. They are here named in the order of their most usual appearance: 1, evenly diffused light in the north; 2, a dark arch whose apex is in the magnetic meridian; 3, streamers; 4, luminous patches, especially in the north-west, sometimes of a red color, often for a long time stationary; 5, colored patches and streamers; 6, merry dancers; 7, corona in the magnetic meridian and equator, the point where the streamers seem by perspective to converge; 8, streamers issuing south from the corona, occasionally extending to near the southern horizon; 9, curtains, with frilled, wavy edges, apparently suspended from the sky; 10, narrow luminous bands, often reaching from the eastern to the western horizon, always at a right angle to the magnetic meridian, but seldom, if ever, coincident with its equator.

As seen from this station by myself, my assistant, and a friend, all of the above features, save the hanging curtains, were simultaneously visible.

That there is a connection between the aurora and sun-spots is quite generally conceded, though denied by some eminent authorities. We know that auroræ frequently occur when no spots are visible on the sun, and that sun-spots are often seen when auroral exhibitions, either boreal or austral, are entirely absent, but to this the advocates of the theory make answer to the former that sun-spots may have been on the other side of the sun, and, to the latter objection, that there may have been auroræ visible only in the Arctic or the Antarctic regions, or in both. But there is need of further confirmatory evidence by the general co-operation of astronomers in the collection of enlarged data for the establishment, modification, or complete rejection of the prevailing theory that sun-spots, auroræ, and terrestrial magnetism are intimately connected.

Intelligence has just reached me that the famous display of July 16 was also witnessed from the southern hemisphere on a scale of grandeur comparable to our own. This simultaneity of the phenomena at both terrestrial poles suggests the question whether this is always the case.

When the writer was a lad, in perhaps the year 1834 or 5, the sky being densely cloudy and the ground covered with snow, he saw at eight o'clock one evening every visible object, especially the snow and sky, suddenly assume a bright crimson red. He wonders if any reader of *Science* recalls that memorable spectacle which appalled so many people. He does not remember to have ever seen an explanation of the ghastly phenomenon from any country where the sky was cloudless, but it was, doubtless, caused by an extraordinarily tinted aurora.

BIOLOGICAL NOTES FROM NEW ZEALAND.

BY GEO. M. THOMSON, DUNEDIN, N.Z.

A VERY interesting feature in connection with the flora of New Zealand is the rarity of those plant structures which are correlated with the presence of mammalia. If we except the spiny *Aciphyllas*, there is not a single species of plant peculiar to these islands which shows any contrivance either for distribution by, or protection against, mammals, even where other species of the same genus are so modified in other parts of the world. *Aciphylla*

genus of tall, rigid, umbelliferous plants, peculiar to the islands, with the exception of a rare and feeble species which occurs on the mountains of eastern Australia. The leaves and bracts of two of the species, in all their subdivisions, end in long, rigid spines, rendering them most formidable plants. The only suggested explanation for the occurrence of such strongly-armed species is that they were thus protected against the moas. This may or may not be true. It may be said in favor of the hypothesis that the moas were extraordinarily abundant in former times and they were vegetable feeders, the contents of their crops, consisting of rounded pebbles and comminuted vegetable fibres, being commonly found. It is also the case that since the introduction of pigs into the colony, these plants have been immensely reduced in numbers. The pigs root up the ground at some little distance from the plant, and so get at it from below.

But, leaving this exceptional case, we find the general statement true with which this note is prefaced. A few examples may be given. The genus *Acæna* consists of small rosaceous herbs which have undergone considerable retrogressive development. The name refers to the spines, formed of the four produced and hardened persistent calyx-lobes which project above the fruit. Of the five species found in New Zealand, two have a wide distribution outside the islands; *A. sanguisorbæ* ranging westwards across Tasmania and Australia, and reappearing in Tristan d'Acunha; while *A. adscendens* is a more Antarctic type, occurring in the Macquarrie Islands, Tierra del Fuego, and the Falkland Islands. In both these species the calyx spines are tipped with small barbed hairs, by means of which the fruit adheres to any passing animal with great persistence. In the other species of the genus which are peculiar to New Zealand, the spines have almost or altogether lost the barbs and the fruit is not distributed widely. The change is not, however, complete in all; thus in *A. microphylla* the spines are strongly developed and occasionally have reversed hairs on their summit. In *A. Buchanani* the spines are feeble and rarely have a few apical hairs, but sometimes they are not developed. Lastly, in *A. inermis* the calyx merely has its angles thickened in fruit, and there are no spines.

The only other New Zealand plants in which the fruit is carried by means of barbs which could catch on to passing animals belong to the genus *Uncinia*, a group of sedges which have the utricle furnished with a long barbed bristle or seta. This forms a most efficient organ for hooking hairs, etc., and it renders the fruit a great pest to dogs. The New Zealand species are, as Hooker says, "difficult of discrimination," and some are so closely allied to Tasmanian or to South American forms as to be almost indistinguishable The genus is widely spread in the Southern Hemisphere, and also occurs as far north as the mountains of Abyssinia. It is clear that the barbed bristle is a character developed outside of these islands and is evidently of great antiquity. In some of the more slender endemic forms it is not very strongly developed, but I know of no species which has lost it.

Spiny and prickly plants are very rare, and, with the exception of the *Aciphyllas* already mentioned, are all Australian. *Discaria toumatou* is probably the same as the Australian *D. australis;* in this plant the leaves are small, and the branches are developed into strong spines which protect it against grazing animals. *Eryngium vesiculosum* is a low-growing umbelliferous plant with very prickly leaves and bracts, but it is a common Australian and Tasmanian species. The same remark applies to *Rubus australis*, but in this case the formidable, recurved prickles, which have earned the plant the name of "bush lawyer," are chiefly of service as climbing organs. There is, indeed, no endemic spiny plant in New Zealand (except *Aciphylla*).

The tendency to lose the protective character is shown in a most instructive manner in a few instances. Thus there are in these islands two species of the myrtaceous genus *Leptospermum*. *L. scoparium*, which is also common in Tasmania, has rigid, pungent leaves, which only an animal with a hard palate could attack with impunity. On the other hand, *L. ericoides*, which is confined to the islands, has quite lost the pungent tip to its leaves, and the foliage and branches are much softer and less rigid.

An exception to the rule here exemplified is afforded by the nettles, of which one endemic species, *Urtica ferox*, is about as diabolical a species as can be met with. Its long, stinging hairs inflict a painful wound. It is difficult to say what they serve to protect the plant from. As if to show that perfection of protective development in one direction does not always serve in another, it is a fact worth noting that this species is so very much attacked by leaf-eating insects that it is often a matter of difficulty to get herbarium specimens quite perfect.

THE PSYCHOLOGICAL LABORATORY AT YALE.

FOR several years Professor Ladd has been lecturing on physiological psychology, using charts, models, microscope slides, etc., for illustration. His earnest desire to have a laboratory for this science finally met its fulfilment last spring. The second, third, and attic floors of a building were given for that purpose, and $1,500 were appropriated for equipping the apartments and for apparatus. Dr. E. W. Scripture, a pupil of Wundt in Leipzig, was called from Clark University to take charge. Orders for apparatus were sent off at once, and the preparation of the rooms went on all summer, so that the work of instruction and research began without a hitch on the first day of the term.

The laboratory consists of fifteen rooms, among which are the lecture room, seminary room, library, chemical, and battery rooms, apparatus room, isolated room, time room, general-research room, and workshop. The workshop contains a screw-cutting lathe and all tools that can be desired for the repair and manufacture of apparatus. A regular mechanic is at work here part of the time. This workshop, which is the most complete one ever put into a psychological laboratory, is regarded as the foundation of research and demonstration work. The plan followed in investing the funds has been to spend as little as possible for mere demonstration apparatus and to reserve nearly all for research work; nevertheless it is of supreme importance to have the lectures on psychology consist almost entirely of demonstrations. This difficulty has been completely solved by the workshop where the apparatus for demonstration is put together or manufactured with sufficient care for the purpose.

Three rooms, including the isolated room, are given over entirely to research. This isolated room is a small room built inside of another room; four springs of rubber and felt are the only points in which it comes in contact with the outer walls. The space between the walls is filled with sawdust as in an ice-box. The room is thus proof against sound and light, and affords an opportunity of making more accurate experiments on the mental condition than yet attempted.

A particularly new feature is the electrical communication between the rooms. It is nearly always necessary to separate the experimenter from the one experimented on; in order to avoid the large number of electrical wires necessary to connect the rooms separately a switchboard has been arranged similar to a telephone switchboard, to which sets of wires run from each room. But this one with fifty-six wires has been put in with the aid of a carpenter at about one-tenth the cost of a telephone-board.

The following courses are given in the laboratory by Dr. Scripture: 1. A regular lecture course in experimental and physiological psychology of one hour per week, for seniors and graduates; the seniors alone recite on another day. 2. A laboratory course in experimental psychology for graduates, conducted on the seminary method by the men themselves. The object is not only to give a thorough knowledge of the psychological work in the laboratory, but to train the men in handling apparatus and in conducting lectures, thus providing a supply of instructors ready to take positions. This course has seventeen members, being exceeded in the graduate department only by Professor Ladd's philosophical courses. 3. Research work. It is the constant endeavor to awaken in the students the spirit of original investigation, this being what America most lacks in its educational life. Men are also encouraged on the principle that one learns most by doing. Last, not least, the fact is recognized that the amount of research done determines the standing of the laboratory in the scientific world. Already six original investigations of the highest class are under way: they include one on attention, in which

several improvements in apparatus and methods of experiment have already been made, one on the time of action and the fatigue of monocular accommodation, another on the rapidity of movement of the arm under the conditions present while writing, another on the reaction-time to tones as dependent on pitch, intensity, duration, etc.

The ample accommodations furnished by the fifteen rooms, the three months of energetic preparation during the summer, the high scientific stand taken in regard to research, the wise patronage of Professor Ladd and the enthusiasm of the young investigators lead us to hope that the first year will see us with a recognized standing, second only to Wundt's laboratory at Leipzig. Nevertheless, there are many difficulties to be overcome; the work of instruction really requires as full an equipment as a physical laboratory; moreover, research is the most expensive kind of work, thus putting a great strain on the appropriation. It would be a very great help if some one or more friends would undertake to support or aid some one of the researches, setting any desired amount as the limit beyond which the expenses are to be paid by the laboratory. We have already received considerable aid in our work: Professor Ladd has given the laboratory his valuable collection of charts and models and a microscope; a friend has donated $75 for electric forks required in one of the researches; the B. F. Sturtevant Co. has sent a rotary blower; the Electric Gas Lighting Co. of Boston has sent a dozen Samson batteries; the Aluminium Brass and Bronze Co. of Bridgeport has made us a dozen discs twelve inches in diameter; the Boston Woven Hose and Rubber Co. has furnished some of their cross-stitched rubber belting; E. B. Meyrowitz has sent a set of test-cards, etc. More of such help would be thankfully received; at present we need a ½ horse-power motor, a spark coil, etc. Possibly the day is not far distant when an endowment will be made for a separate building and a full equipment of apparatus.

HYBRIDISM EXEMPLIFIED IN THE GENUS COLAPTES.

BY SAMUEL N. RHOADS, ACADEMY OF NATURAL SCIENCES, PHILADELPHIA.

PERHAPS the most widespread and persistent tendency to hybridism that exists among the higher vertebrates to-day is to be found in this American genus of woodpeckers. The birds responsible for such a state of affairs are well known in their respective habitats as flickers, the eastern species being named the yellow-shafted flicker (*Colaptes auratus*), and its western congener, the red-shafted flicker (*Colaptes cafer*) by naturalists.

It early became known to explorers in the upper Missouri and Yellowstone regions of this country that where the habitats of these red- and yellow-shafted birds adjoin there often occurred individuals partaking the characters of both species. Audubon described in the appendix to his "North American Birds," a flicker from this region, with the yellow shafts and red nape of *auratus* combined with the red mustaches of *cafer*, as a distinct species, naming it *Picus ayresii*; but as more specimens were secured it became evident that these intermediate birds were not constant in character and their numbers were too great to be explained by any other theory than that they were the offspring of distinct species and were hybrids. Professor Baird enunciated this idea in 1858, classing for convenience all these nondescripts under the distinctive name of *Colaptes hybridus*, and asserting that their existence could be satisfactorily accounted for in no other way. The amount of material on which he based his theory, however, was small enough to warrant other theories, Mr. J. A. Allen attributing the existence of so-called "*hybridus*" to the "action of environment in accordance with certain laws of geographic variation," and later Mr. Ridgway suggested they were "remnants of a generalized form from which two incipient species have been differentiated." Dr. Coues, in 1884, thought the mixed birds might constitute "perhaps a hybrid and perhaps a transitional form," while Hargitt, in the British Museum Catalogue, makes the intermediates a race with the nominal status of a species under the Audubonian name of *ayresii*, admitting them to have been originally the result of a mixed union, showing possibly a "sign of reversion to remote ancestral plumage."

Last year (1891) Mr. J. A. Allen made the relationships of the whole genus the subject of an exhaustive study. The results of his examination are given in full in Vol. IV. of the Bulletin of the New York Museum of Natural History and being inaccessible to the general reader may be briefly summed as follows: —

1. Mixed birds show no stages of geographic variation comparable with those connecting species and sub-species. In the latter the transition is gradual, symmetrical, and correlated with change of environment, but in *Colaptes* the intergradation is irregular, often asymmetrical and without such correlation.

2. Very unlike birds have been found to breed together; diverse offspring being reared in the same nest by parents indifferently exhibiting normal or abnormal characters irrespective of sex. But so far typical *cafer* and *auratus* have not been found paired together.

3. On either side of the boundary of one thousand miles, along which their habitats adjoin, the influence of one species upon the other fades imperceptibly eastward and westward till it disappears.

4. The main area of hybrid distribution covers a belt of country two hundred miles wide and reaching north-westwardly from the Gulf-coast of Texas through Colorado, Wyoming, Montana, northern Idaho and Washington and the southern half of British Columbia to the Pacific, extending from southern Alaska to the mouth of the Columbia River. South and west of this the habitat of true *cafer* reaches from the Columbia to Tehuantepec, while north and east of it pure *auratus* ranges, over an area four times as great, from Florida to Hudson's Bay and from Labrador to Behring Sea.

5. Formerly, collections from certain parts of the far West, notably California and Nevada, were wanting in hybrids, but now they have become so common in some localities that thoroughbred birds are the exception. This favors the assumption that *auratus* is extending its range into the *cafer* region, and the absence of such an invasion of mixed individuals northward indicates that the transmigration is in the historic direction, from north to south.

This, with a few interpolations of my own sums up the evidence which has induced Mr. Allen and the majority of ornithologists to adopt Baird's theory to its fullest extent.

To this I wish to add a few supplementary remarks based on a collection of flickers made this year in British Columbia. As this series was chiefly collected in the breeding period we are relieved of the complications caused by the winter migration of Alaskan *auratus* into the region and can rely on the specimens as representing the domestic relations of the group.

Perhaps nowhere is the proportion of hybrids to pure-bred birds greater than on the Island of Vancouver. The dark, north-western form of *cafer* found here has so thoroughly assimilated the characters of *auratus* that *cafer* is the exception and *cafer-auratus* the rule. Nevertheless, pure *auratus* is very rare on the island. I have no specimens of it, but Mr. Fannin of the Victoria Museum has one, and Mr. Maynard of the same city states they are sometimes numerous in the fall. I am, however, from the absence of such specimens in collections, inclined to discount this statement, in the belief that they will prove to be of impure origin also. Indeed it is doubtful if there is much association, much less admixture, of thoroughbred individuals of the two species either with each other or with hybrids at the present day, many which appear pure, especially among the females, being of impure extraction.

Comparing the results of an examination of seventy skins, contained in the collections of the Academy of Natural Sciences of Philadelphia from debatable territory in the west and north-west, with the deductions given in Mr. Allen's admirable paper, the following general remarks seem in order: —

1. The prevailing tendency among hybrid flickers is in the direction of a symmetrical assumption of the characters of both species, examples of asymmetric coloration being rarely present and chiefly confined to the females.

2. A much larger percentage of male than female birds show mixed parentage. This indicates either that hybridism in t[illegible] case results in an overproduction of males or a disparity [illegible]

relative numbers of the sexes among these hybrids, or it is due to the fact that females assume abnormal secondary sexual characters less readily than males. Until it be proven that hybridism does cause a disparity in the numbers of the sexes we may safely accept the latter explanation.

3 The preponderance of hybrids showing typical coloration of *cafer* combined with the red nuchal crescent of *auratus* contrasted with the scarcity of those showing the yellow and black characters of *auratus* shows a predisposition to acquire red in that part quite in accordance with the general law of coloration in the *Picidæ*, and may be considered a reversion to the characters of some common tropical ancestor from which the two species have originally been derived.

4. This tendency to assume red in preference to yellow or black colors fully accords with the southern dispersion of hybrids into *cafer* territory as contrasted with their non-dispersion into *auratus* territory.

5. The absence of records of pure *auratus* and *cafer* birds pairing together, and the abundance and evident fertility of the hybrids in some regions indicates the majority of hybrids are mongrels, i. e., the offspring of hybrid parent or parents as distinguished from those generated by distinct species.

6. It has been determined[1] that mongrels show a stronger tendency to revert to the characters of either parent than do hydrids. In *cafer-auratus* this would result in the final elimination of the hydrid element among these species. But we have seen that the tendency is toward an increase of this element.

A probable explanation of this may be found in the non-appearance of mixed characters in female hybrids by which pure-bred males are readily induced to pair with them and renew the tendency to variability.

Among the most significant queries which spontaneously arise in the mind regarding the case in hand, we may consider the following with possible profit: first, how did it happen? second, when did it happen? third, what will be the result? and fourth, what part has hybridization in the evolution or extinction of species?

Bearing upon the first question the effect of migration is of special import. In general, flickers are very hardy birds, able to resist the severest weather in sheltered localities as far north as the forty-fifth parallel. Over the country south of this the migration is less a southerly movement than a descent from the mountains into the valleys and a retreat to the densely wooded regions of the sea-coast. That the same conditions prevail on the Pacific coast I am assured by Mr. Fannin.

In the vast central territories of the continent north of the Rocky Mountains the southerly migration is more decided and far-reaching. A look at the map will show that the Rockies, after extending nearly due north through the United States from the headwaters of the Rio Grande to the northern boundary, suddenly contract from their easterly amplification in Montana and incline far to the north-west through British Columbia. South of the boundary along the eastern and western slopes of this vast landmark the migrating hosts of interior flickers of each species would respectively pass without much admixture. But in the headwaters of the Missouri region this movement becomes more complicated owing to the westerly configuration of the mountain system and the corresponding westward extension of the habitat of *auratus* north of it toward southern Alaska. Here the migratory movements of *auratus* first assume the character of an actual invasion of the habitat of *cafer*, and as we go further west the southerly migration of *auratus* from Alaska is directed by physiographic and climatic conditions to the shores of the Pacific, along which, from Sitka to California, resides the darker race of *cafer* known as *Colaptes cafer saturatior*.

It is here that conditions exist more favorable to hybridism between *cafer* and *auratus* than anywhere else along the frontier of their common distribution, and it appears extremely probable that the north-west coast of British Columbia was the first witness to their notorious alliance.

Viewed thus, the history of the distribution and evolution of these species over North America becomes of special interest. Starting with a common ancestry in the tropics and diverging northward over the great eastern and western mountain systems of the continent, they became differentiated in accord with the dissimilarity of their environments.

Readily adaptable to extremes of climate, both forms rapidly extended their northerly range into the border lands of the glacial epoch, *auratus* following its receding pathway along the Appalachian system into the Canadian lowlands and across British America in the westerly direction of the Boreal life zone, while *cafer*, spreading over the table lands of Mexico and across the Mexican boundary, reached the west base of the Rocky Mountains, between which and the Pacific it continued to extend until the changed climatic conditions of the North Pacific coast were encountered. From this point, having assumed the darker coloring of *Cleoptes cafer saturatior* it rapidly extended, under more favored circumstances, until it met the southward migration of Alaskan *auratus* with the result already described.

Bearing upon the second question, that of chronology, we have first pretty sure evidence of a recent extension of the habitat of *auratus* into more southern territory, where it had not formerly been recorded. Coupled with this is discovered a growing abundance of hybrids in the same region, indicating an aggressive movement of *auratus* into new territory.

From the rate of this movement and the breadth of common ground over which these hybrids breed it would appear to be of comparatively recent inception, possibly within the last few hundred years.

Owing to the scarcity of intermediate birds in what is considered the rightful habitat of *auratus*, the transmigration has apparently come from the north and east, over neutral territory, until the habitats of *auratus* and *cafer* adjoined along a line considerably east of the base of the Rocky Mountains, following their extension into British America and crossing them about latitude 33° to the Pacific coast. At this phase of their history the two species were probably unadulterated, the mountains continuing in a modified degree to act as a natural barrier to their further extension. These conditions having now made possible the acquaintance of the species, it is for us to examine whether there were any characters shared by them in common which would predispose the birds to more intimate relations and account for their apparently anomalous conduct. As a result we find that in habits, language, size, proportions, physique, and pattern of coloration the two species are indistinguishable, while in color alone they are different. If we take any animal (man included), and endeavor to bring about a union between different species of the same genus we find that in proportion as the parties to such union resemble each other in habits, language, etc., as above given, they will the more readily accept the situation, other considerations being of no great importance.

This much as regards not only the possibility but the probability of a voluntary union between species so circumstanced. I think we must consider the interbreeding of any two species subjected to similar conditions as not only possible but inevitable. It is not in this respect that the hybrid flickers of North America are unique, but in their persistent fertility and wholesale reproduction over a large area. While this instance has no parallel on so grand a scale in the present history of species, so far as known, it is likely that similar conditions have been and are exerting an important influence in the evolution of life as we now see it.

If this be true, we cannot too curiously consider the relationships of our eastern and western flickers, as time goes on, to determine if possible the laws which govern the progress of interbreeding of species in their natural state and whether they show that hybridization has any part in the evolution of new forms or the extinction of the old.

As observed, the present tendency in *Colaptes* resolves itself into an invasion of the hardier northern race upon their counterparts of the south, with the ready absorption of the characters of the former by the latter. This cross-breeding, in accord with laws now recognized, should produce mixed birds superior in some respects to their parents, combining the hardihood of *auratus* with the handsomer coloration of *cafer* and aggressively extend-

[1] Origin of Species, p. 261.

ing their influence in a manner quite independent of the customs and traditions of either parent, just as they seem to be doing.

Whether they will come to represent a distinct yet intermediate Rocky Mountain species, with *cafer* and *auratus* occupying a diminished habitat south-west and north-east of their enlarged domains, or whether, continuing southward, they will affect *cafer* through its entire range until that species, as such, disappears, replaced by a form combining the type characters of *cafer* with the red nuchal crescent of *auratus*, is a mystery the present cannot solve and the future will be loth to reveal.

CONCERNING OUR WASTE GROUND.

BY J. T. ROTHROCK, WEST CHESTER, PA.

FEW persons, except those who have been west of the Mississippi, have any real conception of the vast areas there which might well come under the head of "Waste Ground." To eastern eyes the miles of desert seem, from any productive standpoint, absolutely hopeless. A little examination, however, may reveal the fact that such a judgment is both hasty and erroneous.

It is quite true that these regions are dry and, at present, deserts whose vegetable productions are mainly cacti, sage-brush, and various species of Chenopodiaceæ. It is so true, though, that the elements of plant life are in the soil, that whenever a spring or a flowing stream appears, a more or less dense vegetable growth is seen also. Hence the western aphorism that the value of a man's farm depends not on its size, but on the quantity of water he can put on it during the growing season.

This preliminary statement leads to a consideration of the subject from two points of view. 1. Are the present natural productions of no value, immediate or prospective? 2. Are we utilizing the rainfall of those desert areas to the greatest advantage? It may be said that this second question starts a vast train of secondary considerations, quite beyond the limits of this paper.

As to the first question, it is a fact that thus far mankind has depended very largely on the more fertile ground for support. This is especially true of our own country. It was, of course, in the natural trend of events that a choice between promising and unpromising areas must of necessity lead to the selection of the promising first — the fertile before the barren, that which could be irrigated before that which could not be. Increasing population has left little choice, and the first problem is. Of what value, if any, are these unattractive forms of desert plant-life? We may eliminate at once, without consideration, the sage-brush and the cacti, because they are of no great promise. The case is otherwise with the Chenopodiaceæ. This order of plants promises much. Its general character, to begin with, indicates latent possibilities. For example, it furnishes the beet, mangel wurzel, garden orach, and several species, also, of the mealy seeds are largely used by our American Indians as food. In South America, quinoa is an established article of food, and comes likewise from this order. Add to the above the fact that *Eurotia lanata*, another representative of the order, is a well known and highly valued forage plant in some of the drier and more alkaline regions of our West, and the case would seem pretty clear that we have to do with an order which is well worthy of extended observation and experiment.

Here then are three points for consideration: (*a*) What plants of the order can be used as food, and what portions of them? (*b*) What does each promise in the way of improvement under *long-continued*, judicious cultivation? (*c*) Is there any way by which such seeds (of this order) as contain active properties can be treated so as to render them fit for food?

The fact at once suggests itself that here is a field of research, which (however promising) is mainly beyond reach of the individual observer. Time is a prime factor in the most important of the three questions. To test the capacity of any species fully for improvement would require *not less than a quarter of a century*, and, more than likely, a much longer period. It is fairly one of the problems which should be referred to a long-lived government, either for direct consideration by its own corps of experimenters, or, perhaps better still, by the agricultural colleges of each State in which such plants grow abundantly.

Among the Labiatæ (or mint family) the Chia (seeds of *Salvia Columbariæ*) appears. Its use among the aborigines dates back beyond our knowledge. We do know, however, that it was among the so-called "Aztec" races of Mexico an article of food, that it was accepted as tribute by the conquerors from the conquered, and that it still holds a place on the diet-list of the California Indians. Such, then, are some of the indications as to possible sources of food-supply which even the barren-ground portions of our country may be made to yield to an increased and hungry future population. Is it not, also, possible that desert plants, having useful properties, might be introduced, from other countries, into our own drier regions, with advantage to us?

The second part of the barren-ground problem — to obtain the largest utility from our rainfall — is already complicated by its association with existing State lines. Take, for example, the condition of affairs in Kansas, Nebraska, and Utah. Much of the water received by those States and the territory comes from the mountain slopes of Colorado, and how much of this water they shall receive depends also upon Colorado. Yet Colorado was the last of all to be settled. The continued prosperity of three earlier-settled States is contingent upon the wants, the caprice, or the cupidity of one later settled State. Clearly, there is something wrong in a political economy which makes such a condition possible. There is no probability that lapse of years will simplify the problem, and at once the question suggests itself as to whether drainage-lines should not promptly be regarded and acted upon as important factors in determining State boundaries. Here one comes in contact with political organization. All the States concerned (by their commissioners at least) must be in accord before any change of boundary can be made. And one can readily see the almost interminable line of contests, between statesmanship on the one hand and politics on the other, which such change will open up.

There is, however, another aspect from which this question can be viewed. Thus water-storage may, to a certain extent, remove the pressure of an inadequate water-supply. There seem to be certain districts, for example, that of the White Mountains of Arizona, where the rainfall is within a very few inches of enough to ensure crops. That this deficiency could be supplied during the growing season from storage basins seems more than probable. The exact method of constructing such basins so as to ensure the safety of the residents on the lower grounds is more doubtful than the benefits possible if the water were once hoarded.

NOTES AND NEWS.

PROFESSOR GEO. R. VINE of Sheffield, England, has recently distributed a report of a committee of the British Association for the Advancement of Science, appointed to investigate Cretaceous Polyzoa. In this conclusion to a series of investigations extending over a number of years, we have discussions of the species occurring in various sections, together with a catalogue of the Polyzoa found in the Chatham Chalk. In this, references are given to the original place of description of the genera and species, the classification of D'Orbigny being followed to a large extent. There is finally a catalogue of the species of British Cretaceous Polyzoa, numbering 283 species, with references to place of description and the geological or zonal distribution. Students of Polyzoa must be grateful to Professor Vine for the great amount of work he has done at various times upon this difficult group. In a second paper, reprinted from the Proceedings of the Yorkshire Geological and Polytechnic Society, Professor Vine describes and illustrates some new species, and remarks upon many others from Cretaceous horizons.

— "Mother and Child" is a compendium of modern scientific knowledge of the relationship between the parent and her family, which J. B. Lippincott Company will publish at an early day. It is prepared by Drs. E. P. Davis and John M. Keating, and contains information which is of importance to women's well-being, as well as in regard to the varied diseases of children. It is specially adapted to domestic use, but will also be valuable for trained nurses and the medical profession.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE GREEN MOUNTAINS' ANTICLINAL.

BY C. H. HITCHCOCK, HANOVER, N.H.

THE key which is to unlock the intricacies of New England geology is to be found in the discovery of the proper structure of the Green and Hoosac Mountains. Hence in the occupation of this field for careful investigation the United States Geological Survey has acted wisely; and one cannot restrain impatience with the officials of the printing office, who have had the completed manuscripts descriptive of these results in their hands for more than two years, and have not published them.

The pioneers of American geology referred this Green Mountain range to the "Primary" series, chiefly because, in their view, all foliated crystalline rocks belonged there. Of course any sections illustrative of their notions from the theoretical standpoint would exhibit the anticlinal structure. But their actual illustrations, compiled from observation, do not support their theory; as shown by C. T. Jackson's section across the White and Green Mountains, and E. Hitchcock's sections across the Hoosac Mountain. Hence it was that the geological literature of thirty and forty years' standing is pervaded with extreme applications of metamorphism. C. B. Adams, in the second report upon the geology of Vermont, in 1846 (p. 168), raised the query whether the occurrence of the quartz rock, limestone, and talcose schists upon the east side of the Green Mountains, in Plymouth and elsewhere, did not include the repetition of the Taconic rocks over an azoic foundation. He offered this suggestion as something worthy of investigation. His successors in the study of Vermont geology attempted to discover the structure of the mountains, as well as of all parts of the State, by measuring thirteen sections across the territory from east to west. A summary of the results was given by E. Hitchcock in the final report, page 252; from which it would appear that the structure of the Green Mountains was anticlinal. His contemporary, Logan, insisted that this structure was synclinal. The later studies of the writer, in several publications, confirm the first view, which is also held by Selwyn, the successor of Logan as director of the Canadian Geological Survey.

Having had occasion recently to examine the rocks of Hoosac Mountain and the neighborhood, the writer desires to offer the following observations. The excavation of the Hoosac tunnel has afforded us the opportunity of observing the structure of the interior of this mountain compared with what may be seen at the surface; and it was stated in Macfarlane's Railway Guide, 1879, that Hoosac "Mountain is believed to be an inverted and very much crushed anticlinal." Professor R. Pumpelly, in his paper upon secular rock-disintegration in the Bulletin of the Geological Society of America, vol. II., presents a map covering a part of this mountain, which shows the distribution, first, of a central core of granitoid gneiss; second, a coarsely foliated, often white, gneiss, supposed to be the dynamic product of a Cambrian conglomerate; third, the Hoosac schists, which wrap around and over the gneisses; and, fourth, the quartzite, which is the basal member of the Cambrian, known familiarly as the "granular quartz" of Emmons. The anticlinal fold is therefore easily recognized. The granitoid gneiss in the centre crops out upon the mountain a mile or so south of the tunnel, and the arch dips ten degrees northerly, and the rock is exposed where cut by the excavation. It is made up of blue quartz, large microcline crystals, somewhat elongated and assuming the augen habit, together with the greenish mica, chlorite, and epidote of the foliation. It is said to be the equivalent of the gneiss of Clarksburg Mountain. The Vermont geology described this rock as the Stamford granite (gneiss), and speaks of it at several places farther north also. Our New Hampshire studies enable us to correlate this central granitoid augen gneiss with the "porphyritic granite, or gneiss," said to lie at the foundation of the stratigraphical column. In New Hampshire the mica is commonly biotite, while the greenish micas at the tunnel are more suggestive of the later protogene, called "Bethlehem gneiss." As the chloritic mineral is the result of alteration, its presence is not definitive. But the augen gneiss seems to constitute the foundation upon which the later gneisses were disposed in both localities.

There must be a decided unconformity between the augen and the overlying white conglomerate gneiss. This is shown not so much by a decided divergence in the angle of dip as by the general principle that a conglomerate is necessarily unconformable to the original rock from which the fragments have been derived. Some would say the augen gneiss was of igneous origin; and, if so, the discordance would be equally marked.

This Hoosac gneiss, or its equivalent, must be manifested in the Shelburne Falls anticlinal area, the Halifax-Reading ranges, and others farther east and north. Each range has the anticlinal attitude, while the intervening basins are of newer rocks. Next to the Green Mountains structure, the succession of gneissic waves capped by hornblende schist have aided us in working out the stratigraphy of the New England crystallines.

The proper place for the Hoosac schists may be an open question. E. Hitchcock, in his map of 1844, made the Graylock, Hoosac (west side), and the Charlemont schistose areas equivalents; and perhaps this is the most natural view. We must, however, remember that these hydro-micaceous and chloritic schists are not confined to a single horizon. There are, first, those of the Green Mountain gneiss, described as pre-Cambrian; second, those of the granular quartz, or Lower Cambrian; third, those of the Berkshire and Graylock terranes, as pointed out by Dale, and corresponding to the magnesian slate of Emmons. Hence there may be reason for the reference of the Hoosac schists to any of four different horizons that best explain the dips.

The Stockbridge limestone is evidently repeated on the east side of the anticlinal at Plymouth, Vt. Whether it once extended along the whole range and has been eroded, or is represented by an equivalent terrane, or is wanting, remains to be discovered.

BOTANY AT THE EXPERIMENT STATIONS.

BY GEORGE F. ATKINSON, BOTANICAL DEPARTMENT, CORNELL UNIVERSITY.

A REMARKABLE stimulus to botanical investigation has been given in the last few years through the opportunities offered by the organization of botanical departments at the various State experiment stations. The acquisition by the States of the congressional fund has afforded means, hitherto possessed only by a few favored institutions, for the purchase of the expensive apparatus and libraries of technical works needed in modern biological research. It also provides for the employment of men who devote part or the whole of their time to original study and the practical application of the results. The fund was designed not only for the purpose of treating economic botany in a practical way, but also for the purpose of pure science study, which in many cases must precede any practical treatment.

Studies of forage plants, of the improvement of sorts by the selection of seed, cross-fertilization, the distribution and harmfulness of weeds, the relations of micro-organisms to the fertility of soils, besides many subjects appertaining more or less to horti-

cultural science, are some of the subjects which engage the earnest efforts of the station botanist.

Perhaps one of the most unique features of the botanist's work at the experiment stations is the study and treatment of plant diseases caused by fungi and bacteria. Nearly all the stations where a botanist is employed give considerable attention to experimentation in various ways for preventing or remedying plant maladies This is certainly called for, at least the experiment stations should in some way carry on such experimentation, for the prevention of plant diseases is the desired good for which any appropriation for this study is given. There is also a popular demand for results which mean dollars and cents saved for the farm and garden. In some cases, perhaps, this necessitates a sacrifice of the careful study into the cause of the disease. It is gratifying, however, to note that at a number of the stations the importance of original investigation into the cause of plant diseases is recognized. Already important results have been reached. Important in clearing the way for successful treatment, but also important contributions are being annually made to the biology of little-known and obscure forms of plant life. In such a large number of recently organized stations, much chaff will be published, but time will winnow that from the kernel.

In looking over the work of the station botanists, it is interesting to observe the number who are engaged in making use of artificial cultures in studying the life histories of parasitic fungi. The different habits and appearances of the real enemy are brought to light, its plans of attack are studied; proof of its harmfulness can be established by inoculation, and known causes thus supplant supposed ones. No other feature of botanical work at the experiment stations, in my judgment, is doing so much to lay the permanent foundations for a rational economy in the treatment of plant diseases. The best work of this kind can only be successfully carried out with the aid of expensive modern apparatus appertaining to bacteriological laboratories. This provides the trained workman with the tools for proceeding rationally and accurately to the desired end. The stations which at present are provided, more or less completely, with such cultural apparatus are the following:

Alabama, Connecticut (New Haven), Delaware, Illinois, Indiana, Iowa, Kansas. Kentucky, Massachusetts (Amherst). New Jersey, Cornell University Station. N.Y., New York Station (Geneva), North Corolina, North Dakota.

Several workers in other stations feel the need of cultural apparatus in their work. It is to be hoped that another year will find this want provided for.

During the past year the force of botanical workers has been increased by the organization of departments at the following stations: Arizona, Florida, New Mexico, South Dakota, and Texas, the officer at the latter place being horticulturist in charge of botany.

Several changes have been made in the working force. At the Alabama station Atkinson retired Oct. 1, 1892. At the Kansas station Hitchcock was appointed to succeed Kellerman. In Massachusetts, Humphrey retires January 1, 1893. In Michigan the station work has been reorganized and C. F. Wheeler appointed botanist. Craig has been made botanist in Oregon. In New York, at the Cornell University Experiment Station, Dudley retires to accept a position in Leland Stanford, Jr., University, and Atkinson of Alabama has been appointed cryptogamic botanist.

In looking over the report of the chairman of the Section of Botany of the American Association of Agricultural Colleges and Experiment Stations, which met at New Orleans Nov. 16, we note the work of the botanists at the different stations as follows: —

Alabama. Mell (botanist and meteorologist in charge of phanerogamic botany) is engaged upon a study of the economic grasses and weeds of the State, and in crossing varieties of cotton.

Atkinson (biologist in charge of plant pathology) has continued his studies of cotton diseases, has discovered a new "damping-off" fungus, obtained pure cultures of Pammel's *Ozonium* of root-rot of cotton in Texas, is studying the biology of the organisms which cause leguminous tubercles, and the teratological growths caused by *Taphrina*, *Rœstelea*, and root fungi.[1]

[1] For continuation see Cornell University Experiment Station, N.Y.

Arizona. Tuomey (botanist) is making observations on the adaptability of the native grasses, trees, and shrubs for cultivation.

California. Green (botanist) is at work upon the vast native flora of the State.

Connecticut (New Haven). Sturgis (mycologist) is studying the diseases of tobacco, and making experiments in curing tobacco and spraying fruits and garden crops. He is beginning a critical study of the *Cribrariaceæ*.

Delaware. Chester (mycologist) is engaged upon studies of *Monilia fructigena*, diseases of watermelons, muskmelons, cucumbers, and the winter killing of blackberries. He has reached promising results in the treatment of peach-rot.

Florida. Rolfs (botanist and entomologist) has recently entered upon his duties, studying plant diseases.

Illinois. Burrill (botanist and horticulturist) is studying bacterial diseases of plants; raspberry rust, *Manilia* of plum, and economic smuts.

Indiana. Arthur (botanist) is investigating the normal growth of the potato, the relation of the number of eyes on a tuber or part of a tuber to the number of stalks produced and to the yield. s also studying the enzyme in seeds of wheat and oats, the relation of green seed to early maturity, wheat-smuts, and has devised a method of preventing rust and bacterial disease of carnations.

Iowa. Pammel (botanist) is studying life history of *Peziza sclerotiorum*, *Rhizoctonia betæ*, and *Cercospora beticola*. Has experimented on effect of fungicides upon roots and germination of seeds, crossing of cucurbits, treatment of plant diseases, and is at work on the chromogenic bacteria of the Ames flora and anatomy of cucurbits.

Kansas. Hitchcock (botanist) is experimenting with fungicides on seeds, and studying the biology of weeds and economic *Uredineæ*.

Kentucky. Garman (entomologist and botanist) is engaged upon comparative study of forage plants.

Maine. Harvey (botanist and entomologist) is making collections of economic plants.

Massachusetts. Humphrey (vegetable physiologist) has been studying black-knot of plum, a violet disease, a new disease of cucumbers, and is publishing a monograph of N. A. *Saprolegniaceæ*.

Mississippi. Tracy (director and botanist) is making a botanical survey of the State, and working on the *Gramineæ*, southern tomato blight, and a new disease of the grape.

Nebraska. Bessey (botanist) is making an exhaustive study of the native trees and shrubs, and native and cultivated grasses. Is at work on diseases of the sugar-beet.

New Jersey. Halsted (botanist and horticulturist) is working on diseases of cranbury, rose, violet, hazel, and fungi of weeds, and experimenting for treatment of celery and sweet potato diseases.

Cornell University Station, N.Y. Atkinson (cryptogamic botanist) is engaged upon a study of winter blight of tomatoes, a new tomato disease, a *Botrytis* disease of beans, carnation diseases, a new anthracnose of *Ligustrum*, and "damping off" fungi.[1]

New York (Geneva). Beach (horticulturist) is studying the effect of copper compounds in soil on vegetation, has obtained good results from Bordeaux mixture and selection of seed for anthracnose of beans, and from Bordeaux mixture for *Septoria* on chrysanthemums. Has treated also apple and potato scab, raspberry anthracnose, gooseberry mildew, strawberry-leaf blight, and celery diseases.

New Mexico. Wooton (botanist) is collecting plants for an herbarium.

North Carolina. McCarthy (botanist) is engaged in seed-testing, treatment of grape and tomato diseases, and studying bacteria of nitrification.

North Dakota. Bolley (botanist) has found corrosive sublimate effective in preventing potato scab; is studying the fungus of deep scab of potatoes, making attempts at artificial cultures of the *Uredineæ*, and working on the distribution of root tubercles of the *Leguminoseæ*.

Ohio. Miss Detmers (botanist) is collecting the *Uredineæ* of the State.

[1] See also Alabama.

Oregon. Craig (botanist) is working on weeds, forage plants, and plant diseases.

Pennsylvania. Buckhout (botanist) is engaged in forestry and hybridization, and working on the practical side of potato-rot and downy mildew of the grape.

Rhode Island. Kinney (horticulturist and acting botanist) has reached important results in the treatment of seed-potatoes with Bordeaux mixture to prevent potato-scab; is also treating seeds.

South Dakota Williams (botanist) is making observations on forage plants suited to varying conditions in different parts of the State, and studying plum-pockets and a geranium disease.

Tennessee. Scribner (director and botanist) has published a list of the grasses of the State in the form of a p pular edition, to be followed by a more technical one.

Texas. Price (horticulturist) is treating cotton and grape diseases.

Utah The entomologist is acting-botanist.

Virginia. Smythe has charge of phanerogamic botany. Alwood (horticulturist) is studying apple-leaf diseases and experimenting on weak solutions of copper salts for plant diseases.

Vermont. Jones (botanist) has made a test of the comparative value of a number of the standard fungicides on potato-rot (*Phytophthora infestans*).

Wisconsin. Goff (horticulturist) is working on apple-scab and experimenting on the germination of seeds.

Mention should also be made of the work of the Division of Vegetable Pathology, Department of Agriculture, Washington, with its corps of half a dozen workers carrying on important and fruitful investigations, the larger subjects of investigation at present being a mysterious vine disease in California, orange diseases in Florida, and fruit diseases in New York.

A large number of the experiment station botanists do more or less teaching, since most of the stations are connected with, or located near, the State agricultural colleges. This large field of work for specialists offers one of the best openings for young men desirous of becoming either investigators or teachers. New fields are opening each year and changes are being made, so that for some time there will be a demand for young men not only well trained in general botanical science, but those who also have improved the opportunities presented for familiarizing themselves with methods of artificial cultures of micro-organisms and fungi. The call for original investigation at the experiment stations implies with it better equipment than would possibly be supplied under other circumstances at many of the State colleges. This affords, then, the ambitious teacher good facilities for being at the same time an investigator, while it also offers the investigator good opportunities for experience in teaching.

This dual responsibility becomes burdensome if too much of either is required without ample assistance; but, in many cases, teaching duties are lessened in order to give time for the investigation. When the burden is not too great, an ambitious young man with strength and enthusiasm is likely soon to be promoted to greater positions of trust carrying a less number of the more irksome duties

THE RETICULATED STRUCTURE OF HUMAN RED BLOOD-CORPUSCLES.

BY DR. ALFRED C. STOKES, TRENTON, N. J.

WHATEVER the histologist may believe in regard to the reticulated structure of the human red blood-corpuscles, whether he accepts it as normal structure or not, he cannot fail to be impressed by the beauty of the minute plexus of fibrils, or to be gratified by the ease with which the net-work structure will explain certain physiological problems. But since Dr. Louis Elsberg, in 1879, first announced his discovery of this structure in the human red corpuscles, the subject seems not to have attracted, among histologists, the attention it deserves. It has been ridiculed by some, just why I have never understood, as the announcement was certainly of sufficient interest to merit further investigation in all seriousness, and while some prominent histologists were disposed to accept Elsberg's observations as demonstrable, his conclusions were pretty generally waved aside with scant courtesy. Klein, of England, seems to be one of the believers in the existence of the reticulation within the red blood-corpuscles as normal structure, while Ranvier, the learned French histologist and professor in the College of France, dismisses the subject in a single sentence in his treatise on human histology, saying that the reticulum is an illusion produced by wrinkles on the surface of the corpuscle, and letting it go at that. Ranvier's dictum should properly dispose less well-informed students to be cautious in their statements, and especially in their belief in what their own eye sight seems to show them. Yet after the corpuscles have been exposed to the action of a five per cent solution of potassium bichromate, the reticulated appearance is so distinct, it is so constantly present, and the most authoritative investigators are so sure that the bichromate of potassium in solution can have no deleterious effect on the most delicate protoplasmic structure, that in the mind of every microscopist that sees the reticulations in the red corpuscles from his own blood, there must be an unconquerable doubt as to the correctness of Ranvier's opinion and assertion. The net-work, or the corrugated surface, is so exceedingly minute, even when studied with the best high power objectives, that mere superficial examination can scarcely hope to decide whether the appearances are due to wrinkles on the surface, or to a reticulation below it, although the aspect is certainly much less like a wrinkling than like a reticulum. The net like collection of fibrils is too regularly and too evenly developed to impress the observer with the belief that it is a collection of wrinkles only or even chiefly.

The action of water on the red corpuscles in such that they soon become inflated and finally invisible. They are not dissolved but are rendered invisible, as a drop of any aniline stain run under the thin glass covering these invisible bodies will demonstrate, by again bringing them into view. The five per cent solution of potassium bichromate also distends the corpuscles, not to the same extent, it is true, as does water alone, yet the distention is conspicuous. It is natural, therefore, to suppose that, although the reticulations and the bodies bearing them are not even microscopically large, yet if the appearances are due to a net-work of surface wrinkles produced by the potassium salt, the absorption of the water carrying the salt, and the consequent distention of the corpuscle, should have a tendency to lessen the number of the wrinkles and likewise to lessen their prominence, but this is not the result.

To investigate the subject for my own personal gratification, I submitted red blood-corpuscles to the action of a five per cent solution of potassium bichromate for an hour, then transferred them to a cell of some depth in which was an exceedingly weak solution of the same salt, hoping that the action of the water would still further distend the corpuscles and, at least to a certain extent, obliterate the surface markings, if they were such. In numerous corpuscles the result was that hoped for, so far as distention was concerned, the bodies in many cases becoming almost globular. A touch of a fine needle-point on the cover-glass rolled over and over beneath the objective, yet, distended as they were, the reticulation was in no way undefined nor uncertain. It surely was not less conspicuous; it actually seemed more prominent, an effect readily explainable by the elongation in all directions of the internal fibrils, if they existed, and the consequent enlarging of the inter-fibrillar spaces.

By pressure on the cover glass it is not difficult to crush such distended corpuscles, and, although the result is always an indescribable deformity, the reticulation is still to be seen plainly in some specimens, and to show some traces of its existence in all.

Under such circumstances, too, it is not impossible to cut a corpuscle in two by drawing a fine needle across the thin cover-glass. In my experiment the needle cut only a single one of the sub-spherical globules, it is true, but that separation was accidentally accomplished so completely, and the two parts were studied so long and carefully, that there remains no doubt in my mind as to the correctness of the observation or of the interpretation. A single globule had been cut, not entirely into two parts, but so nearly in t[illegible] the currents in the medium had lifted

one portion and thrown it aside, at the same time twisting the little ligature still connecting the parts, the effect being such that the two might be compared to two watch-glasses adherent at one side by the edges, but with the concavity of one directed away from the convexity of the other, the two concavities therefore looking in opposite directions. If there ever was a chance to look into the interior of a distended and sectioned red blood-corpuscle this was it, although the whole was the result of a fortunate accident and of nothing else. It was good luck with no good management, for I could never repeat the experiment with even a similar success. But with an achromatic condenser, N. A. 1.0, and with Reichert's semi-apochromatic, oil-immersion one-twelfth inch objective, N. A. 1.40, each of those two parts of the same red corpuscle was seen to be filled with a distinct and conspicuous reticulum, as a saucer or a watch-glass might be filled with a flat-topped sponge.

The result of this effort at rough-and-ready cutting of the red corpuscles was so pleasing, that the thought of a deliberate sectioning with a microtome was fascinating, and the hope of a still more perfect exhibition of the reticulum within the sections was too great to be long postponed. It is, of course, impossible for the most expert microtomist to select a red corpuscle, put it into position on its narrow edge after having submitted it to the action of the bichromate of potassium solution, to embed it, and then to slice it up in the microtome. A section parallel with the broad surfaces of the corpuscle would not answer the purpose, and indeed, if such a section could be made, the microscope and the microscopist himself might remain blind to the result. It would hardly be possible to know that such a section had been produced, since the microscopical appearances of the entire, uncut corpuscle must be similar to any section possibly made in the direction mentioned. The cutting must therefore be done in a direction transverse to the broad surface of the corpuscle, that is, at right angles to that aspect. Even to cut once across an object only $\frac{1}{3200}$ inch in diameter would be impossible with but a single specimen to work on. The method that occurred to me is one that would naturally occur to any one, and when I suggested it to my correspondents, Mr. Ludwig Reiderer of New York City and Dr. Edward Gray of Santa Cruz, California, they kindly promised to make the experiment and to send me the resultant slides, as they did. The method was simply to submit a large amount of blood to the action of a five per cent solution of potassium bichromate, and to embed a large quantity of the corpuscles without any other preparation, the belief being that some of the numerous corpuscles would place themselves in a position to be sectioned transversely. The tendency of these special objects is to arrange themselves so that the broad surfaces shall be horizontal. If, then, the embedding medium containing them should be turned over, so that the knife should pass through it at right angles to its plane upper surface, the chances were that some of the corpuscles would be sectioned as desired, and at least once across. More than one section of a single corpuscle was not even dreamed of. The results justified the expectation. While not many corpuscles were sectioned, I still found fourteen on one slide, some being admirably cut. These were enough to give an opportunity to look into the interior, and to show that my rough-and-ready method of cutting with a needle-point on the cover-glass, although only an accident, gave as correct a picture of the structure as the more elaborate methods of my correspondents, which, of a truth, were almost equally only an accidental success.

A section of a red corpuscle set up on its narrow uncut edge and looked at from above, that is, with the cut surface upward, is not always panduriform in outline after treatment with the bichromate solution. Whilst some are perfectly pandurate, the majority are variously changed in form by the potassium salt, the outlines being semi-circular, plano-convex, concavo-convex, or "crossed," that is, double convex with the convexities of different curvatures. The specimens panduriform in outline were few in number in these experiments, but they did exist, and were studied with rather more satisfaction than were the other forms, which, although not having the normal outlines, were not altered in structure, if the histologists are correct when they assure us that the bichromate of potassium has no deleterious action on protoplasm.

These as well as all the sections were carefully and repeatedly examined with light passed through blue glass, and with the achromatic condenser and the oil-immersion objective already mentioned. The result justified the conclusion reached by means of the happy accident that I have referred to so repeatedly. The apparent reticulation is a true reticulation and in no way a surface wrinkling. The net-work is made up of minute fibrils that produce an internal reticulum that, at least after the action of the bichromate salt, fill the entire internal part of the human red corpuscle. Upon the thickened, firmer surface that simulates an external membranous cell-wall, even after taking into consideration unavoidable diffraction effects, there is no evidence of a wrinkling. On the surface of certain of the corpuscles that were accidentally set upright, that is, vertically on their narrow edge, but escaped the knife, there were absolutely no signs of any roughness or of any wrinkling. The surface outlines were as smooth and as even as they could possibly be. I am convinced that the reticulation, under the effect of the bichromate of potassium solution, exists, not on the surface but within the body of the human red blood-corpuscle; and if the potassium salt has no deleterious effect on protoplasm, then the reticulation is a normal structure, and the net-work of protoplasmic fibrils is a natural and constant constituent of the red blood-corpuscles. Yet the doubt is great and prominent. How that doubt is to be dispelled I must leave to microscopists that are more expert histologists than am I.

In all the corpuscles lying horizontally on the slide a nucleus-like body was conspicuous, the net-work of fibrils being always connected with it, the nucleus-like body being itself circular in optical section and inconstant in position. In but two corpuscles that had been certainly cut transversely was a nucleus-like body observable. In others, if it existed the section did not happen to pass through it. In one of the two instances referred to, there were two minutely elliptical bodies present, one near each extremity of the section, whilst in the other only a single object of the kind was visible near one end. If a nucleus exists in the red blood-corpuscles, judging from these two examples, it is disciform, as would naturally be supposed. That the appearance should be so prominently visible in most of the corpuscles thus treated, is at least suggestive.

There is in connection with this internal structure a question that should be answered, or at least investigated by those that have access to the murderers in New York State, of whom there are usually several on hand. What is the effect, if any, of the fatal electrical current on the reticulation? That the corpuscles are altered in size and in shape is well known, especially to those that have seen the preparations of the blood from William Kemmler, the first murderer executed in the electrical chair. But nothing was at that time done to learn if there had been any change in the reticulations within the corpuscles, and, so far as I know, nothing of the kind was even thought of. To remove a sufficient quantity of blood that had certainly been under the influence of the electrical current, and to subject it to the action of the bichromate solution, would not be difficult for any competent microscopist that might have access to the criminal's body immediately after the execution. That the reticulations exist within the corpuscles I am convinced; that the electrical current would make a change of any kind in those reticulations is one of the many things that I should like to know. The investigation, too, might go some distance toward deciding as to the normal existence of the net-work. If the killing current alters the corpuscles in form and in size, as it does, it is reasonable to suppose that changes should take place in the internal structure, if there normally is any internal structure. There have been many widely differing kinds of suggestions as to what practical use murderers should be put; there seems to be a desire to make them of some service after death or even before death, for scientific experiments. Some competent microscopist within convenient distance of New York's State Prison at Auburn, may thus make good use of one murderer by investigating this interesting question.

Histologists claim to have proved that a solution of potassium bichromate does not alter the structure of protoplasm. If this be

true, then the reticulation within the red blood-corpuscles is a normal structure; if not true, then the whole body of histological work which has been accepted as correct must be doubted and be revised, because about the first thing the histologist does with his specimen is to plunge it into a solution of potassium bichromate. Indeed, he does more, for he not rarely uses Müller's fluid, which is a mixed solution of potassium bichromate and of sodium sulphate. There seem to be two horns to the dilemma, and the microscopist that seizes either is likely to be gored by the other.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Cretaceous at Gay Head, Martha's Vineyard.

IN his article on "Gay Head," published in this journal of Sept. 23, and since supplemented in the Transactions of the Maryland Academy of Sciences (pp 304–312), my friend Professor Uhler furnishes a valuable contribution to the geological literature on that peculiarly interesting promontory, through applying to the task of unravelling the complicated structure of the Vineyard series the knowledge and experience gained in his painstaking and excellent studies of the Lower Cretaceous terranes between New York Bay and the James River. Professor Uhler is the first, in print, to apply, in the interpretation of the disturbed strata in the western portion of Martha's Vineyard, the general principles which he was first to discover in the mode of disposition of the same series in the Middle Atlantic States. To one somewhat familiar with the Middle and Lower Cretaceous of New Jersey and Maryland, the homologies forcibly indicated in the Vineyard series are full of fascinating interest.

While agreeing with Professor Uhler as to the general structure of the original Cretaceous series in Martha's Vineyard, i.e., in the existence of a lower portion, essentially clays, succeeded by deposits of sands, lignitic clays, often somewhat laminated, and alternate clays and sands,— the observations of Professor Shaler and those of us who have viewed the cliffs for several successive seasons have taught the fallibility of indulging in a detailed correlation of the entire section as exposed during a single summer. Each season presents new phases and unsettled local stratigraphic complications, revealed by the winter's storms, as may be noted by consulting Professor Shaler's very valuable memoir, published in the Seventh Annual Report of the U. S. Geological Survey (pp. 297–363, 12 plates), the same author's paper in the Bulletin of the Geological Society of America (Vol. I., pp. 443–452, pl ix.) (neither article is mentioned by Professor Uhler), or in my notes made during 1889, 1890, and 1891. It seems to me, therefore, that Professor Uhler has been a little confident and hasty in naming up the various terranes at Gay Head. In offering some friendly comments on his conclusions, it is not my purpose to discuss several important questions, such as whether the island has been submerged "five times" or only three, or matters of nomenclature, as, for example, whether the underlying clay series should be called "Potomac" or Amboy, or the more arenaceous portion designated as "Raritan," "Albirupean," etc. These questions, as well as those concerning unconformability and the order and relations of the various members of the lower half of the Cretaceous in this region, as well as in other Atlantic coast States will, I trust, soon be considered in full by Professor Lester F. Ward of the U. S Geological Survey, who has made them the subject of special study, and who is far more competent to discuss them than the present writer. The folding, crushing, faulting, and dislocations at Gay Head make a unique example in the Cretaceous and Tertiary of the eastern United States. It is difficult to account for the surprising altitudes of the clays and lignites, as well as extensive elevation and pre-Tertiary erosion, with no other agency than pressure and the encroachment of the sea. In fact, the strata are so disturbed, eroded, mingled with, and masked by, post-Cretaceous deposits that it is, in my opinion, hazardous, in many portions of the section, to attempt more than the application of the general principle of distinction between the lower portion, with more massive clays, and the upper part, embracing variously arranged clays and sands

The greensand toward the north end of the section is much contorted, as described; but my own excavations in search of fossils fail to corroborate my friend's hypothesis that the Tertiary fossils "have settled into the broken surface," the interior of the marl being, in his judgment, equivalent to the lower marl of New Jersey, and carrying Cretaceous fossils only. If such is the explanation of the occurrence of Tertiary fossils on the face of the greensand, it is remarkable that they have not, likewise, settled into the broken surface of the clays and sands on either side. A similar marl was seen well exposed in the season of 1889 at one or two points towards the eastern end of the Weyquosque cliffs in Chilmark, where at one place the materials in the margin of the terrane appear to have been beautifully sorted in Pleistocene or post-Pleistocene time.

With Professor Uhler I agree that the greater portion of the strata below the "ossiferous" conglomerate, which appears to be Miocene, is probably Cretaceous in age. As to whether the more massive clays are equivalent to the plastic clays of the Potomac in the Maryland region, I shall not question in this place, merely mentioning the occurrence of Dicotyledonous remains among the dark clays at high-tide level near that portion of the section which I understand my friend to pronounce Potomac. It is possible, of course, that this terrane had slipped down from the upper part of the cliff, and may be regarded by Professor Uhler as "Raritan." The latter name suggests the remark, that, while referring the lower clays to the "Potomac," and explaining that the superimposed series, called "Raritan," is equivalent to the upper part of his "Albirupean," Professor Uhler makes no mention of the presence or absence of the rest of, or the lower portion of, the Albirupean, theoretically intervening between the Raritan and Potomac as defined by him.

So far as I now know, my paper on "Cretaceous Plants from Martha's Vineyard," read at the December meeting of the Geological Society in 1889,[1] was the first in which the opinion was expressed, or evidence adduced to show that a part, at least, of the Vineyard series represents an eastward extension of the Amboy clays to the southward of New England. The opinion expressed by Dr. Newberry, when delivering his judgment on my drawings, that "there can be no doubt that they represent the flora of the Amboy clays," and his view that these clays passed through the entire length of Long Island, have, I think, been fully justified. During the following summer, 1890, evidence was collected which proved the correctness of those views regarding the Gay Head region, while my unpublished notes, made the same season, indicate the extension of the Amboy clays in place as far east as Northport and Fresh Ponds in Long Island, while material probably derived from that series, when not in place, was observed at numerous points, among which are Wyandance, Farmingdale, possibly near Riverhead, and in Gardiner's Island. I anticipate that a careful search among the Pleistocene material between the Firehole and Montauk Point will reveal Amboy elements, showing a continuance eastward to the Cretaceous material observed by myself in the north-east and south bluffs of Block Island. On Martha's Vineyard the Amboy clays may be seen in place at several points in the vicinity of Peaked Hill, while its material, perhaps re-deposited, may be traced to Lambert's Cove, or farther. Concretions with Amboy plants have been collected on the shore of Lagoon Pond, above Vineyard Haven, while Professor Thomas Battey of Providence has sent me similar specimens from East Chop and Cottage City, on the east coast, showing the probable extension, in past if not in present, of that important series of clays and sands as far, at least, as the eastern border of the island.

The greater identity of the Amboy (Middle or Lower-Middle Cretaceous) flora with that of the Lower Atane beds of Greenland, instead of with the Dakota group of the United States, is remarkable,[2] and strongly impels one to search for other evidence

[1] Abstract, Bull. G. S. A., I., pp. 554, 555; Printed in full in A. J. S., xxxix., 1890, pp. 98–101, pl. ii.

[2] See A. J. S., l.c., p. 99, and Newberry's remarks, Bull. G. S. A., I., p. 555.

of a middle or lower Cretaceous connection with Greenland, an hypothesis fully in harmony with the views of a connecting off-shore Tertiary terrane, advanced by certain Neocene palæontologists.

There remain still many problems in the stratigraphy and chronology of Gay Head. Next year will doubtless offer opportunities for fresh conclusions, at least on subordinate points, to my friend or any other geologist. There may even be good reasons for the sincere entertainment of almost fundamentally different opinions on the part of an equally skilful observer.

Among other problems, not merely local, is the circumstance that, notwithstanding the incompatibility and irrationality of the idea in view of present continental geography and topography, no other inherent evidence has, I believe, been found as to the deposition of the clays and sands of this series except such as tends to support the view of Professor Uhler that these middle or lower Cretaceous terranes are essentially fresh water formations.

DAVID WHITE.

Washington, D.C., Nov. 16.

On the Vernacular Name of the Genus Harporhynchus.

THAT well-known genus of American birds, of which *Harporhynchus rufus* is the type, is almost universally called in English, by every ornithologist, or indeed by every one who knows the species in the United States, a *Thrasher*. In New England, and to the southward and westward, it is known as the Brown Thrasher. We find it printed Thrasher in the A. O. U. Check-List, without any synonymic term or terms, as is also the case in such an authoritative work as Coues's "Key to North American Birds." Now it is of interest to know that our British ornithological friends call these birds Threshers, spelled with an *e* in the first syllable, instead of an *a*. Recently Professor Alfred Newton submitted me the proof of a contribution of mine to his extensive work on Ornithology, now passing through the press, wherein this word occurred,—spelled Thrasher in my text, but Thresher in a supplementary note of his own. Upon his attention being called to it, I received from him the following in his reply: "I have not the least wish to interfere with your use of Thrashers,—there is some authority for it among English writers,—but I believe Thresher to be more correct (A. S., perscan or pirscan; Mid. Engl., preschen; Chaucer, threshen; Scal., preskja; Old Dutch, derschen; Germ., dreschen; Gothic, thrisken) and prefer that form for my own use—though, of course, giving it the sound of short ă, as in many other words, e.g., Derby. Thrash would seem to indicate a pronunciation like Thrăsh (almost thrarsh)—which is local and vulgar. A. N." This communication is dated Magdalene College, Cambridge, England, Nov. 12, 1892. According to this it would seem that our old, time-honored name of Thrasher, strictly speaking, should give way to the more correct appellation of Thresher.

R. W. SHUFELDT.

Takoma, D. C., Nov. 29.

Meteoric Shower.

THE meteoric shower here on the evening of Nov. 23 was very fine. The average of several observations, from 7 to 10 P.M., gave 250 good-sized meteors per minute, with a great many very small ones resembling a fiery dust. The meteors appeared to radiate from a point nearly overhead at 9 P.M.

C. W. KEMPTON.

Austerlitz Mine, Oro Blanco, Pima County, Ariz., Nov. 26.

Remains of the Mastodon Recently Found in Tennessee.

NEAR Niebert's Springs, seven miles south-east of Knoxville, some workmen recently unearthed four molar teeth of the mastodon, which were in a fair state of preservation. They were found beneath about thirty inches of yellow tenaceous clay, containing water-worn stones. The largest tooth measured sixteen inches in circumference, and bears on its grinding surface one small and four large ridges, which are covered to the depth of one fourth of an inch with perfectly preserved enamel. The smallest tooth measures twelve inches in circumference, and has only three transverse ridges, whose surfaces are so worn as to expose the dentine in a number of places. The roots are so decayed and broken that it is impossible to determine their original length or number.

The University of Tennessee has in its possession other remains recently found in Hawkins County of this State. These consist of part of a tusk, measuring twenty-two inches in circumference by twelve inches in length, and a molar tooth with only two ridges. The tooth is well preserved; but the tusk is much decayed.

S. W. MCCALLIE.

University of Tennessee, Knoxville, Tenn.

The Humming-Bird's Food.

THE notes that have recently appeared in *Science* regarding the humming-bird's food, would seem to show that the bird's taste varies with the locality. In southern New York their favorite flower is the swamp-thistle (*Cirsium muticum*). No better place could be selected for studying the feeding-habits of the ruby-throats than a spot where these flowers abound. Dr. Gibbs thinks the individual flowers of the red clover too small for the ruby-throat's attention, but in the thistles the flowers are even smaller. Since it has been said that the bee gets pollen but not honey from the thistle, it would appear that the birds visit these flowers for insects. There is scarcely a flower that contains so many minute insects as a thistle-head. Examine one with a lens and it will be found to contain many insects that can hardly be seen with the unaided eye. If the ruby-throat eats insects at all, these are the ones it would take; and because the larger ones remained the observer might conclude that none were eaten.

WILLARD N. CLUTE.

Binghampton, New York, Nov. 21.

AMONG THE PUBLISHERS.

"GENERAL TAYLOR," a biography by Major-General O. O. Howard, U. S. A., will follow Mahan's "Farragut" in the Great Commander Series published by D. Appleton & Co. General Howard has visited the scenes of Taylor's campaigns in Mexico, and his book will be found to be an authority for those who are interested in the military history of our country. This biography contains a portrait and several maps.

—Macmillan & Co. announce the publication of a new work on the heavens and their origin, under the title of "The Visible Universe," by J. Ellard Gore, F.R.A.S., the author of "Star Groups," etc. The book is a discussion of the theories which have been advanced from time to time as to the construction of the heavens, celestial chemistry, stellar distances and motions, etc., and is illustrated by stellar photographs and lithographic plates.

—The January *St. Nicholas* will contain the opening paper in a series that magazine is to print on leading American cities, illustrated. In this article Colonel T. W. Higginson describes Boston in a way to interest boys and girls in the literary history of that city. For future numbers of *St. Nicholas*, Dr. Lyman Abbott will write of Brooklyn, Edmund Clarence Stedman will describe New York, and other famous residents of the different cities will describe them.

—"Electric Light Cables and the Distribution of Electricity," by Stuart A. Russell, is the latest volume in the Specialists' Series (London, Whittaker & Co.; New York, Macmillan). The recent extension of electric lighting from large central stations has brought to the front many problems connected with the economical distribution of electricity over large areas; and to the discussion and elucidation of these problems this volume is devoted. In its 319 pages the author presents a clear, reasonably comprehensive, and fully illustrated description of the various systems of distribution and types of conductor now in use, and suggests the directions in which future improvements will be made. Price, $2.25.

—The Appalachian Mountain Club has just published a second work, with the title, "The Land of the Cliff-Dwellers," from the pen of Mr. Frederick H. Chapin. The region to which the reader

is introduced is south-western Colorado, and, in particular, the curious cañons of the Mesa Verde, which have been only recently explored and found unusually rich in abandoned homes of the cliff-dwellers; one is also made acquainted with the beautiful mountain scenery of the San Juan country, through which the cañon district of the Rio Mancos is approached from the north. The introductory chapters present in brief the history of the settlement of the south-west from the earliest Spanish explorations to the recent Anglo-American occupation. Then follows the personal narrative of the author's visits to the region, with a detailed account of his researches. Mountain-climbers will find the story of the ascents of Mount Snaefell and Uncompahgre Peak of special interest. The work is profusely illustrated. The 180 pages of text are interspersed with some 60 full-page illustrations, heliotypes, and "half-tones." "The Land of the Cliff-Dwellers" can be procured of the sales-agents of the Club, Messrs. W. B. Clarke & Co., 340 Washington Street, Boston.

—"American Mental Arithmetic" is the title of one of the American Book Company's latest school-books, by A. M. Bailey, professor of Mathematics in the Kansas State Normal School at Emporia, Kan. The designation "American" is doubtless given to the volume from purely patriotic motives, as there is no apparent reason why it would not be a good book to use in any school where the English language prevails. Price, 35 cents.

—Charles L. Webster & Co. announce that they have arranged with Henry George for the publication of his new work, "A Perplexed Philosopher," being an examination of Mr. Herbert Spencer's various utterances on the land question, with incidental reference to his synthetic philosophy. They have also arranged with Mr. George for the control of his former books and will issue them in a uniform edition. In "A Perplexed Philosopher" the main argument is an examination of Mr. Spencer's position on the land question. In 1850 Mr. Spencer issued his first book, "Social Statics," in which he denied the justice of the present treatment of land. Later he seemed anxious to minimize and explain away these utterances, and finally he formally withdrew them. In his last book, "Justice," the recants and opposes them. Mr. George brings together and analyzes these various utterances. He also directly attacks the Spencerian idea of evolution,—that is to say, the idea of evolution that eliminates the spiritual element and assumes that the hypothesis of an intelligent Creator is unnecessary. Mr. George argues in favor of the spiritual element in evolution, and the necessity of an intelligent Creator.

—"Induction Coils" is the title of a practical manual for amateur electricians, written by G. E. Bonney (author of "The Electro-Platers' Handbook") and published by Macmillan & Co. The volume is a 12mo of 228 pages, with upwards of a hundred illustrations, and gives a general insight into the construction of ordinary spark coils, medical coils, and batteries for working them. The various chapters treat respectively of inductive theories and experiments, the construction of intensity coils, accessories to coils, special forms of induction coils, some famous coils, batteries, repairs, and useful notes on coils. To these are added a table of copper-wire properties and a list of conductors and insulators. Price, $1.

—Charles Scribner's Sons announce "Etruscan-Roman Remains in Popular Tradition," by Charles Godfrey Leland. It is only within a few years that Mr. Leland discovered what is now for the first time published in this book, that there exists among the peasantry of secluded mountain districts in Italy, as well as among the numerous fortune-tellers or "witches" of the cities, a vast amount of ancient Etruscan or Roman traditions of extremely varied and interesting character. That no scholars had ever surmised the existence of this lore is due to the fact that it is now in a great measure kept secret, as being strictly forbidden by the priests, and connected with fortune-telling, which is punished by the law. It consists of a worship or invocation of the ancient deities, in which the names and attributes of nearly all

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Nov. 29.—Arthur MacDonald, Genius and Insanity as forms of Abnormality; W. H. Holmes, Ancient Quarrymen of South Mountain; H. C. Mercer, Ancient Jasper Quarries in Pennsylvania.

Dec. 6.—Robert Fletcher, The Poet—is He Born, Not Made? James Mooney, Report of Special Committee on Aboriginal Geographic Names in the Potomac Region; followed by Continuation of Symposium upon same subject, by B. A. Colonna, John W. Douglass, O. T. Mason, and others.

Biological Society, Washington.

Dec. 3.—B. W. Evermann, The Cruise of the U. S. Fish Commission Steamer Albatross in Alaskan Waters in 1892; Geo. Vasey, Some New Grasses; J. N. Rose, On the Rediscovery of Certain Rare Plants; C. Hart Merriam, Exhibition of a Complete Series of the Large American Ground Squirrels of the Subgenus Otospermophilus; B. E. Fernow, The Mathematics of Forest Growth.

Society of Natural History, Boston.

Dec. 7.—Leon S. Griswold, Some Indian Quarries in Arkansas; Roland Thaxter, Notes on a New Order of Schizomycetes (Bacteria).

Appalachian Mountain Club, Boston.

Dec. 6.—A paper describing a trip through the White Mountains, and illustrated with the lantern, was presented by a member of the club.

Dec. 14.—G. Frederick Wright, The Discovery and Significance of the Glacial Outlet from Lake Huron to the Ottawa River.

Society for the Advancement of Science, Las Cruces, N.M.

Dec. 1.—C. H. Tyler Townsend, Notes on the Occurrence of the Puma (Felis concolor L.) in Southern Mew Mexico; Hiram Hadley, Alkali Soils; E. O. Wooton, Notes on the Ferns of the Organs.

Publications Received at Editor's Office.

CHILDHOOD: A Monthly Magazine of all that Concerns the Welfare of the Child. Vol. I., No. I. New York. 40 p. 4°. $1 per year.

EDWARDS, W. S. Coals and Cokes in West Virginia. Cincinnati, Robert Clarke & Co. 162 p. 8°.

HART, A. B. Formation of the Union. Epochs of American History Series. New York and London, Longmans. 278 p., maps. 12°. $1 25.

HERTWIG, OSCAR. Text-book of the Embryology of Man and Mammals. Tr. from third German edition by E. L. Mark. New York, Macmillan. 670 p. 8°. $5.25.

JUKES-BROWNE, A. J. The Student's Handbook of Physical Geology. 2d ed. New York, Macmillan. 666 p. 12°. $2.25.

STERNBERG, GEO. M. Manual of Bacteriology. New York, Wood. 886 p 8°.

THE INQUISITOR: A Monthly Journal of Science in Plain Language. Vol. I., No. I. Chicago. 20 p. 4°. $1 per year.

WILLIAMS, GEO. H. Geological Map of Baltimore and Vicinity. Baltimore, Johns Hopkins Press. f°.

the old Etruscan gods are still very accurately preserved, with those of the minor Roman rural deities, a very great number of magic ceremonies, medical cures, and preparation of amulets, accompanied with incantations, and all, as appears by the best authority, of classical origin. Thus of the one hundred very ancient Etruscan-Roman magical remedies collected by Marcellus in the fourth century, our author has found about fifty still in use. There are also given many strange beliefs connected with the occult virtues of plants and minerals, of spirits in all natural objects, the reappearance of ancestors' souls in their descendants, of Magonia, the city in the sky, where hail is made, and last, not least, a number of legends connected with these subjects — in all of which may be traced the most striking parallels with passages in ancient Latin writers; showing how much that has long supposed to be dead and forgotten still exists in the memories of modern believers in witchcraft. The same firm also announces a popular edition of the "Cyclopædia of Painters and Paintings," edited by John Denison Champlin, Jr., and Charles C. Perkins.

— The second edition of "The Horticulturist's Rule-Book," by L. H. Bailey, has just been issued by the Rural Publishing Company (Times Building, New York). It has been thoroughly revised, and brought down to the beginning of the year 1892. The volume is a useful and convenient compendium of information for fruit-growers, "truck" gardeners, florists, and others interested in horticulture. The opening chapters are devoted to insecticides, injurious insects, fungicides, plant diseases, and animal pests. These are followed by chapters on weeds and moss, grafting, seed-tables, planting-tables, maturities, yields, and multiplication, etc.

— From Frederick Warne & Co., London and New York, we have received "Electricity up to Date, for Light, Power, and Traction," by John B. Verity, M. Inst., E.E. It is a small volume of 178 pages, bound in vellum, and contains a folding map showing the areas allotted to various electric-supply companies in London. The book is intended for the general public, not for the electrician, and consequently Mr. Verity has treated the subject in as popular a manner as its nature will admit. (Price 75 cents.)

— "A Review of the Systems of Ethics founded on the Theories of Evolution," by C. M. Williams, soon to be issued by Macmillan & Co., is one of the more important books of the year. The work is a substantial volume of over 500 pages, divided into two parts of nearly equal length, of which the first is historical, giving in detail the position of each of the prominent writers on Evolutional Ethics; while the second or constructive portion presents the combined results of such independent investigations in chapters dealing with the concepts of evolution; intelligence and "end;" thought, feeling, and will; egoism and altruism; conscience and the moral progress of the race; the ideal and the way of its attainment.

— The progress which has characterized American mining and metallurgy during the past quarter of a century and which has made them standards and models for the whole world has been due, in no small degree, to the *Engineering and Mining Journal.* This paper has not only made those engaged in these industries familiar with the best practice in every part of the world, but it has itself created a practical technical literature of inestimable value to those engaged in mining, metallurgy, and general engineering. The collection and publication in the *Engineering and Mining Journal* of reliable statistics of the mineral industry of the United States, within a few days of the close of each year, is an achievement which has elicited the admiration of statisticians and business men in every part of the world. This work has become so important that this year its publication will require a large separate volume, which will be issued in January, 1893. The constant improvement and greatly increased cost of the *Engineering and Mining Journal* necessitate and justify the increase of its subscription to $5.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale.—A new Model U. S. Army Hospital Microscope (Zentmayer), also 1/6-inch and 1½-inch Objectives. HENRY C. WELLS, 151 Broadway, New York.

For sale or exchange.—A Stevens' new model pocket shot-gun, 44 cal., with 22-cal. rifle barrel. Just the thing for collecting birds and small mammals. Will exchange for a 22-cal. cane-gun or good books on ornithology. Write for particulars, stating what you have for exchange. R. C. McGREGOR, 2841 Champa st., Denver, Col.

For sale.—A very fine stone sword (?) so named by myself. It is perfect—15 inches in length, a little over 2 inches in width, and ½ inch thick. It is of a dark slate color, perhaps limestone, and is the largest implement of the kind known. Some fifteen years ago, when it was not mine, I was offered $40 for it; since that time it has come into my possession; that price will now buy it. Address Rev. C. FOSTER WILLIAMS, Ashwood, Tenn.

For exchange. — Fine specimens of Wis. fresh-water pearls. I want books or papers on marine and fresh-water algæ; also classified specimens of same. I will exchange for Smithsonian reports or crystallized minerals. D. M. ANDREWS, Dodge Centre, Minn.

For Sale or Exchange.—The undersigned has a lot of first-class duplicate bird's skins and sets of eggs, both rare and common, for sale or acceptable exchange. Also about two hundred second class skins and five hundred eggs, suitable for study specimens, at very low figures. The latter, for starting a collection, are as good as the best, embracing all classes and nearly all families. Also about forty species of fossils, principally Devonian. MORRIS GIBBS, M.D., Kalamazoo, Mich.

Wants.

A GRADUATE ENGINEER will give instruction evenings in geometry, trigonometry and surveying, mechanics, physics, mechanical drawing and general engineering construction. Five years' experience in field and editorial work on engineering journal. References furnished. C. S. H., 102 Tribune Building, New York.

A POSITION is desired in the South, preferably the Gulf States, where I can teach the sciences Can also instruct in other branches. Salary only nominal, as I am simply desirous of employment while spending the winter in the South. A private family preferred, but will accept regular school work if not too confining. MORRIS GIBBS, M.D., Kalamazoo, Mich.

WANTED.—By well-qualified and experienced science master and associate of the Royal School of Mines, London, aged 26 (at present in England), a mastership in technical college or university for any of the following subjects: Engineering sciences, geology and mineralogy, physics, chemistry and metallurgy, etc., etc. Can provide excellent references and credentials. Apply, J. G., 17 Sussex St., Rochdale, England.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems, fossils, shells, archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Hortter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.

CHEMIST AND ENGINEER, graduate German Polytechnic, Organic and Analytical, desires a position in laboratory or chemical works. Address 218½ E. 7th Street, New York, care Levy.

SCIENCE

NEW YORK, DECEMBER 16, 1892.

A BREATHING WELL IN LOGAN COUNTY, KANSAS.[1]

BY J. T. WILLARD, MANHATTAN, KANSAS.

FOR a number of years, Mr. R. L. Smith of Winona has noticed that two wells there blow out air at times and draw it in at other times. He has also noticed a close connection between their action and the weather. One well he has noticed more especially, and became so satisfied that the movement of air was connected with the state of the atmosphere that he called it a natural barometer. He was very anxious that the well should be observed by some scientific man with the necessary instruments. An aneroid barometer was sent him to make observations with, at the same time recording the state of the well. His observations indicated quite clearly that the movement of air in and out of the well was dependent on the pressure of the atmosphere. As the case seemed interesting, the writer visited the well, taking with him an excellent mercurial barometer and such other apparatus as seemed likely to be useful.

The well was found to be a bored one, cased with lumber. It was about eight inches in diameter. Water is reached in this region at about 130 feet, but this particular well has been drilled much deeper. This fact has no influence on the blowing of air, however, as other wells in the vicinity not over 135 feet deep show the same phenomenon. The well is abandoned now, on account of machinery having been lost in it, which interferes with its use.

On reaching the well, the writer first sealed the top, by means of mortar and plaster of Paris, air-tight, inserting a one-fourth-inch brass tube to connect the well with a gauge. The gauge consisted of a simple U-tube of glass, bent so that the two limbs were side by side. The bend of the tube and for several inches up was filled with water, and a scale behind the glass tubes measured any difference in height between the two columns of water. On connecting this gauge with the well, if air had been blowing out, its tension was measured by the height to which the water in the outer limb rose above that in the inner. If, on the contrary, air was being drawn into the well, on attaching the gauge, the water would stand higher in the inner limb. The following abstract from the observations made during four days will serve to show the connection between the movement of air to and from the well, and the fluctuations of the barometer: —

Date.	Time.	Barometer in millimeters.	Gauge in millimeters.[2]
Aug. 27	4.30 P.M.	674.15	29
" "	5.30 "	673 75	28
" "	6.30 "	673.65	23
" "	7.55 "	673 60	21
" "	9.00 "	673.70	16
" 28	6.15 A.M.	674.30	0
" "	7.45 "	674.35	1
" "	8.45 "	674.15	2
" "	9.35 "	674.45	0
" "	8.45 P.M.	678.50	− 31
" 29	7.25 A.M.	681.15	− 33
" "	8.30 "	681.55	− 31
" "	10.00 "	681.90	− 30
" "	11.30 "	681.90	− 24
" "	1.00 P.M.	681.65	− 17
" "	3.40 "	681.40	− 10

[1] Read before the Kansas Academy of Science, Oct. 13, 1892.

[2] The minus sign indicates a drawing-in of air, the water standing higher in the inner limb of the gauge.

The observations made showed conclusively that, the air of the well being stationary, if the barometer fell, the air of the well at once exerted a pressure outward, as shown by the water-gauge. Should the barometer then remain stationary, the tension of the air of the well became gradually less until equilibrium was again established. As this well was closed by the gauge, the evidence was conclusive that the tension was relieved by the escape of air from other openings, probably neighboring wells. Equilibrium being established, should the barometer rise, the gauge showed that the tension of the air of the well was less than that of the atmosphere, and this inequality was corrected by an inflow of air. If, after a fall of the barometer, a rise should ensue before equilibrium was established, the gauge would still show a greater internal tension. The well was therefore less delicate than the barometer, because of the interval of time required for the necessary movement of the air. After a sudden and considerable change of the barometer a strong movemont of air to or from the well would be caused, and this movement would continue for some hours, even though the barometer might be returning to its original height.

These wells doubtless tap a subterranean reservoir of air, probably filling the interstices of sand or gravel beds. When the pressure of the external air is diminished, some of this imprisoned air escapes, and the greater the fall of the barometer, the greater the force with which the air is expelled. My friend Mr. Smith utilized this air-current to blow a whistle which could be heard all over the town, warning the inhabitants of a possible storm. With a rising barometer, caused by an increase in the pressure of the air, air would be forced back into the subterranean reservoir. Mr. Smith tells me that when the air is going into the well, the water recedes a certain amount, and that when the air is blowing out, it can be heard bubbling through the water.

SOME ENTOMOLOGICAL FACTORS IN THE PROBLEM OF COUNTRY FENCES.[1]

BY F. M. WEBSTER, OHIO AGRICULTURAL EXPERIMENT STATION, WOOSTER, O.

THE subject of country fences has been frequently considered, both as to matters of device and material, by bodies both scientific and otherwise, and from almost every conceivable standpoint, except from that of an entomologist. As a rule, man will utilize for the purpose of constructing fences whatever available material may be the most abundant in his locality. In New England, where rocks are nearly everywhere over-abundant, the stone-wall will probably predominate in future. On the prairies of the west, where rock is a valuable material and timber equally so, a fence of living trees or shrubs, which can be planted, or one composed largely of iron, will occupy a position similar to the stone-wall of the eastern States. In the south, where timber is abundant, we may still look for its extravagant use, in the old Virginia worm fence composed of rails. To this, however, there are some exceptions. In Louisiana and portions of the south, barbed wire is largely used, for the reason given me by a Louisiana planter, viz., that the improvident negro cannot carry it away for fuel.

There is no denying the fact, that some of these forms of fences are harborers of a vast number of insects. In this respect the old worm-rail fence, with its wide margin of neglected ground on each side, stands probably at the head, followed closely by the stone-wall and hedge. A fence that has been very popular over a large portion of the country lying between the Alleghenies and longitude 97° west, is composed of posts and boards, the former set at distances of from six to eight feet apart, the latter, from

[1] Read before the Biological Society of Washington, Nov. 19.

one to five in number, being nailed horizontally to them. In this case, the uncultivated or ungrazed margin is greatly reduced, but even this form of fence offers some protection to various species of insects. Any one who will observe the number of cocoons and eggs that are ensconced between the boards and posts, where these come in contact, will be astonished at their number, especially if his examinations be made during late autumn or winter.

The minimum protection is probably afforded by a fence constructed of posts and wire. The vegetation can be grazed off or otherwise removed, reducing the protection thus afforded to the least possible amount, and the wires offer no hiding-place where they are attached to the posts. It is this form of fence that is, to a very large extent, displacing all others except the stone-wall, especially throughout the area above mentioned, and this change materially reduces the protection before offered a considerable number of injurious insects. Of the species thus more or less fostered may be cited the chinch bug, *Blissus leucopterus* Say, which passes the winter protected by the thick covering of leaves and matted grass. The army worm, *Leucania unipuncta* Haw., often originates in such places in abundance. A large portion of the larvæ of the Stalk Borer, *Hydrœcia nitela* Cauen, pass the early part of their larval stage in the stems of grass growing in such localities. Grasshoppers breed there in abundance. The Fall Web-worm, *Hypantria cunea* Drury, delights to pass its adolescent stage in the crevices about rail and board fences and stone-walls. If, as is often the case, the border of fields along the line of and in the corners of such fences, is allowed to grow up in a wilderness of blackberry and raspberry bushes, these will harbor the Root-borer, *Bembecia marginata* Harris, the Raspberry Saw-fly, *Selandria rubi* Harr., and the author of the Gouty gall of the raspberry, *Agrilus ruficollis* Fab. The Tarnished Plant-bug, *Lygus pratensis* Linn., will pass its winters in comfort among the leaves of mullein which adorn such places, and which constitute a veritable nursery for these and other injurious insects, from which they readily spread to adjoining gardens, orchards, and fields.

Soon after the adoption of barbed wire as a fence material, it was discovered that domestic animals were more or less liable to injury from the barbs. This led to a modification, to the extent of placing one board horizontally above the wires, and, while done especially for the protection of animals, it has an entomological and botanical signification which was wholly unlooked for, even by the entomologist or botanist.

The fall brood of the larvæ of *Spilosoma virginica* Fabr., familiarly known as the Common Yellow Bear, reaches maturity in September and early October, and appears to then acquire a somewhat nomadic habit of life, possibly being in search of a suitable place for cocooning. In their travels they seem to take advantage of fences and convert them into highways, over which they travel in great numbers. Now, with a fence of rails or boards, the travel is distributed over all of these, though the uppermost seems to be preferred. A barbed wire fence is well-nigh impassable for these caterpillars, on account of the difficulty of crawling along the wires and over an occasional barb which stands in the way. The addition of the top board to a fence of barbed wire settles the transportation problem with these larvæ, and they crawl along these, upon the upper edge, in great numbers; but, as with mankind, disaster overtakes them in the midst of prosperity. This fall brood of larvæ seems especially liable to attack from a fungous disease, *Empusa aulicæ* Reich, as determined for me by Dr. Thaxter, of Harvard University. A caterpillar when affected by this Empusa becomes first paralyzed and limp, but later it is rigid and attached so tenaciously to the board that it only disappears by becoming disintegrated and washed off by rains. Now, when a caterpillar dies from this cause it usually becomes firmly affixed, right in the way of the migrating larvæ, so that one of these can scarce pass in either direction without rubbing against the corpse, as the way is only an inch in width. In thus coming in contact with the dead body of its fellow, in all probability some of the spores of Empusa become attached to its body and soon do their work, the dead as before lying in the narrow path and adding to the danger for other travellers. You can readily see that in a short time the narrow way will become so filled with dead that to travel for any distance along this highway without contracting this fungoid disease is almost an impossibility. In proof of this, the upper edge of this board, where it is used, becomes literally strewn with corpses. In a distance of forty-eight feet I recently counted seventeen dead caterpillars, and clustered on the surface of the upper end of a post, comprising an area of two by six inches, six bodies were observed. As these caterpillars are not gregarious, and being general feeders, their chances of being reached by the spores of Empusa is comparatively small unless they rub against a diseased larva, or come within a certain radius of such a one when the spores are thrown off or "shot," as it is termed. Hence, as now appears, this mortality is largely due to the cause indicated, and which seems to be a powerful agent in holding the species in check.

It may be suggested that these larvæ might have been attacked before they made their way to the fences, as it is, I believe, a characteristic of Empusa that its hosts seek high objects, and crawl up as far as possible before dying. In my own observation, while this has proved true in the majority of cases, affected insects have been observed to travel about but little after reaching such elevation. Furthermore, these caterpillars have been observed in abundance crawling along fences when Empusa did not appear to be present.

WATCHING A SNAKE FOR AN HOUR.

BY WALDO DENNIS.

ONE bright morning in July I was walking in the woods, when a snake crossed my path only a few feet in front of me. It was about two feet long, and its dark blotches made it resemble a water snake. It had not been disturbed by my presence, as it moved very slowly, and this slow movement led me to watch it.

It scarcely crossed the path before it began to ascend a medium-sized dogwood tree (*Cornus Florida*). This to me was a coveted opportunity. The story of an eye-witness as to how a blacksnake had climbed the naked corner of a house to a height of ten feet had left me curious to see something of the kind myself.

The dogwood tree, near the ground, was about seven inches in diameter, and was a rather smooth-barked one. The tree leaned but slightly for about ten feet of its height, but then it curved sharply to a horizontal, making the highest part of the body about fifteen feet from the ground. The snake started up on the under side of the slant, and apparently found no more trouble going up the tree than it had in going over the ground. It made no effort to wind itself around the tree nor to hug the tree by winding back and forth, as the blacksnake had been reported to do on the corner of the house. It went straight up without crook or turn.

After ascending about three feet, it seemed to feel its hold weaken, and threw its body into folds. But this was only for a few inches of its course, and it found no occasion to repeat even this expedient. The very acute angles of two or three of the folds, however, showed how well this could be done when necessary. When such a protuberance as a knot came in its way, it seemed to care very little for its advantage, and left it to one side.

After getting up four or five feet, it stopped; being anxious that it should go on up, and fearing it would come down, I touched it with a stick, whereupon it moved faster, gliding quickly out of my reach, showing thus that it had been going so slowly from choice, and not from any difficulty in going faster. When it was about eight feet high it stopped again, which made me have recourse to a larger stick. When it had reached the highest point from the ground, I shook the tree, as well as one could a tree of such size, to see if it could keep its hold. This it did, only lifting up its head and poking it out from the tree, where it lay, four or five inches, as if to see what was the matter. It occurred to me to wonder how it would manage its descent, so I left off experimenting in this line and retired to watch.

I had to wait but a few minutes before the snake began to turn round by doubling on itself. But after crawling along toward

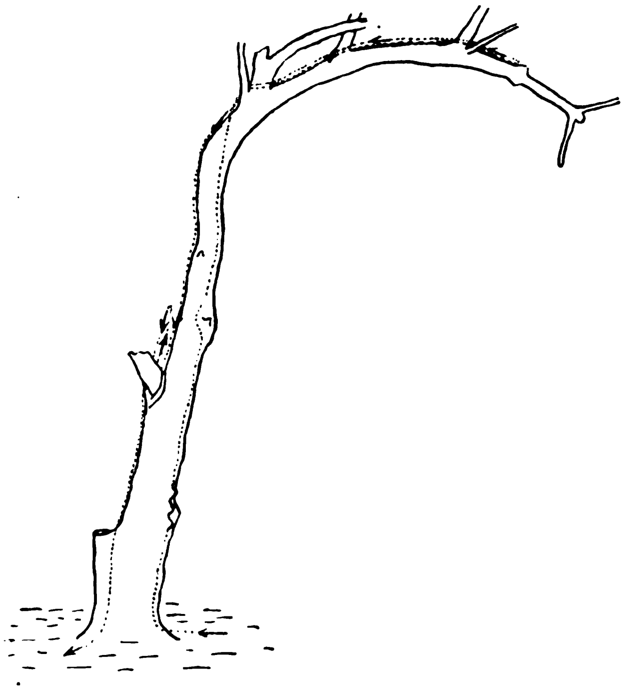
the base of the tree for a foot, it contented itself with basking in the sun.

While lying thus, it lifted up its head four or five inches and gaped. Its mouth opened very wide; but while closing, the nervous spasm, only half expended, again seized upon its jaws, whereupon they went wider than before; the spasm exhausting itself at last in a parting wriggle or two to the head.

So natural was this novel performance, that I involuntarily listened for that characteristic accompaniment, the little agonizing whine so common with the dog, and not uncommon with us.

After a sun-bath of nearly half an hour, the snake began slowly to descend. His course was as straight coming down as it had been going up; but, now being on the top of the trunk, he naturally kept to the outside of the bend. His progress was interrupted with frequent pauses, and at times it was so slow that I could scarcely detect any movement.

When it reached a fork of the tree, about ten feet from the ground, a titmouse came along. It soon discovered the snake and became much excited. Its scoldiing soon brought its mate, when each one, emboldened by the presence of the other, tried to see how much nearer it could go. They hopped all round the snake, now three feet and now scarcely so many inches from it. Had the snake been hunting birds, it would now have needed but



little dexterity to catch one. But the snake paid no attention to them; and after fluttering foolishly near for a time, they paid no further attention to it, flew off, and did not return.

When within about five feet of the ground, the snake paused beside the dead stub of a limb. Swinging its head round toward the stub, it held it there as if intently regarding something it had found. Suddenly its head began slowly to disappear in a hole which I had not noticed. When its head was out of sight, I stepped quite near. It kept gradually forcing its way into the snag until six or eight inches of it had disappeared. All the while it was going in, its body was shrinking and swelling as if it were panting. Evidently it was cautiously smelling its way into what afterwards proved to be a mouse-nest. Possibly it had feasted before on tender, juicy, young mice, and was now promising itself a repetition of such luxuries. When one reflects that stumps, logs, fence-rows, rail-piles, and the like are at the same time the haunts of snakes and the nesting-places of ground-mice and squirrels, he cannot but conjecture how often the helpless young of the latter must fall a prey to snakes. Also, it may be questioned whether the economic value of snakes is not underestimated.

Not finding his game in this instance, however, his highness stiffened himself and withdrew. But, as if loath to give up the treat he had promised himself, he lingered quite a while at the spot, and busied himself in a way which probably accounted for his moving so slowly before, but which from my distance had been unnoticed. He seemed to be using his tongue as a tactile organ on the bark, playing it back and forth from his mouth like a little brush, running it way out, or dropping it down close to his chin, according to the nearness of the piece of bark under inspection. It finally turned up the tree again, carefully sampling the bark as it went. It seemed in quest of something, but what could it find with its tongue? when so evidently, to the eye, there was nothing for a snake to eat. After going but a little ways, he again turned down. But all the way, from here down, it kept up that use of its tongue on the bark. When it reached the ground, it glided off as slowly as before. I now stood by quietly, but did not conceal myself.

The snake had seemed to me to be about two-thirds grown. His not recognizing me as an enemy also showed that he was a young snake, and had not yet learned to be wary of his neighbor's Christian heel. It continued to pause now and then as before, and, as before, I could see its thread-like tongue playing back and forth, licking the way along. But, what was my surprise, at about ten feet from the tree it came down, to see it start up another, this time a jack-oak, about fifteen inches in diameter. The bark in this case was rougher and the climbing must have been easier, but it went up just as slowly as before, and, to the height of three feet at least, its course was just as straight. When so high, I was suddenly struck with the resemblance of the gray blotches of the snake to the gray blotches of bark by which it was surrounded. So much alike were they, that at no greater distance than fifteen feet it was difficult to distinguish certain portions of its body from the bark. To consider this a case of mimicry would strain credulity. The habit of tree-climbing in that case would be common with snakes, and could not go unobserved. That such a practice is commonly observed, certainly is not true. Yet this resemblance, accompanied as it was by such voluntary tree-climbing, if accidental, is, to say the least, remarkable. For certainly we have here a young snake, not more than two-thirds grown. Could this tree-climbing be the exceptional trick of a young snake? Not likely. Any such performance which a young snake takes to so naturally, it must have begun to learn farther back than its grandmother.

However this may be, however probable it is that snakes are decreed to go on their bellies on the ground, I shall, I suppose, hereafter be looking for snakes in trees; and, on meeting one, shall give him every encouragement to show forth a tree-climbing instinct.

I should say that at this juncture I lost the snake, and so was unable to identify him. A flock of cattle browsing in the wood came upon us. While watching to see how near these would come before noticing me, the snake slipped unobserved away.

CURRENT NOTES ON ANTHROPOLOGY.—XX.

[*Edited by D. G. Brinton, M.D., LL.D.*]

Nervous Disease in Low Races and Stages of Culture.

AMONG the errors which have been diligently disseminated by physicians who lacked ethnological information is that which claims that diseases of the nervous system, especially those of a hysterical character, have greatly increased with the development of civilization, and are most common in the races of highest culture.

Both assertions are erroneous. Those intelligent travellers who give the soundest information on this subject report that in uncultivated nations violent and epidemic nervous seizures are very common. Castren descibes them among the Sibiric tribes. An unexpected blow on the outside of a tent will throw its occupants into spasms. The early Jesuit missionaries paint extraordinary pictures of epidemic nervous maladies among the Iroquois and Hurons. The Middle Ages witnessed scenes of this kind, impossible to-day.

In a late number of the *Journal de Medicine*, Paris, Dr. De la Tourette points out the frequency of true hysteria and hysteroid seizures in the Black race, among the Hottentots and the Caffirs of East Africa, and among the natives of Abyssinia and Mada-

gascar. They present frequent cases of classical hysterical attack and occasional epidemics of choreo-mania, affecting both sexes. A negress of the Soudan was lately a patient in the celebrated clinic of Dr. Charcot, in Paris, and displayed the symptoms characteristic of neurosis. Civilization, so far from increasing this class of maladies, is one of the most efficient agents in reducing them in number and severity. When it is freed from certain elements not essential to it, especially religious excitement and competitive anxieties, it acts decidedly as a preventive.

Recent Contributions to American Linguistics.

The limited number of students who interest themselves in the native American languages will welcome the appearance of another of Mr. J. C. Pilling's most excellent bibliographies, this time the "Bibliography of the Athapascan Languages," a work of 125 large octavo double-columned pages, every page testifying to his unbounded industry and model accuracy. I lately showed one of his bibliographies to a distinguished professor of classical archæology, who assured me that in his own much more widely cultivated field there is no bibliographical work done equal to this of Mr. Pilling's.

The Count de Charencey, now probably the most accomplished Maya scholar in Europe, has published at Alençon a Maya translation by Father Ruz of Ripalda's "Catechismo y Doctrina." This was well worth doing, but students of the language should be warned that Father Ruz wrote a Maya of his own manufacture, having "improved" the language so much that the natives scarcely recognized it.

A most valuable addition to Mexican linguistics is a "Ligero Estudio sobre la Lengua Mazateca," by the Licentiate Francisco Belmar, published at Oaxaca this year. The only previous publication on this language was a short paper of my own in the Proceedings of the American Philosophical Society.

M. Raoul de la Grasserie, favorably known from previous careful studies in American linguistics, has issued an "Essai d'une Grammaire et d'un Vocabulaire de la Langue Baniva," one of the Arawack dialects of South America.

Through the kindness of Mr. Wilberforce Eames, librarian of the Lenox Library, I have been enabled to print in the Proceedings of the American Philosophical Society an abstract of a grammar of the Rio Napo dialects, drawn from a manuscript of the last century now in that collection. These dialects belong to the Betoya stock, of which we have had almost no grammatic material.

The already rich literature of the Tupi has received a valuable addition by the reprinting of Father Paulo Restivo's "Arte de la Lengua Guarani," at Stuttgart, under the competent care of Dr. Christian Frederic Seybold. It is particularly valuable for the very full list of particles, with their use and meaning. Dr. Seybold hopes in the future to bring out new editions of the exceedingly rare "Explicacion de el Catecismo en Lengua Guarani," of Nicolas Yapaguay, and the "Katecismo Indico da Lingua Kariris," of Father Bernard de Nantes.

Polynesian Ethnology.

The Polynesian Society, whose headquarters are at Wellington, New Zealand, commenced this year the publication of a quarterly journal devoted to the ethnology, philology, history, and antiquities of Polynesia. The first two numbers contain a collection of generally excellent articles, several of which are printed in the dialects of the islands, with translations. One of some length on the races and prehistoric occupation of the Philippines is a collation from a number of printed sources, not adding new material to our knowledge of the subject. An article on the inscriptions of Easter Island, by Dr. A. Carroll, designed to present translations of the inscribed slabs, is singularly unscientific and out of place. What is worse, he announces other translations in prospect, which he professes to read through the medium of ten different American languages! This is enough, or should be enough, to secure the non-publication of his paper by any learned society.

A number of lists of ancestors, native genealogies, are given. In some instances these extend for a hundred generations, the children being carefully taught to repeat them accurately. The length of a generation is estimated at about twenty years, so a maximum of two thousand years would be covered by these records.

The Aryan Question.

This question, which, like Banquo's ghost, "will not down," came prominently forward at the last meeting of the German Anthropological Society, held during the first week of August in Ulm.

Dr. Von Luschan took the opportunity to make an onslaught on Professor Penka's well-known hypothesis that Scandinavia was the original home of the European race. The trouble is, that at a time when we know a large part of Europe was well peopled, Scandinavia was covered with a vast glacier; and no evidence that its soil was occupied during the "Old Stone Age" has yet been adduced. This should be enough to suppress Penka.

The distinguished craniologist, Professor Kollmann of Basel, declared on the strength of skull-forms that there must have lived in Europe in neolithic times at least three, if not four, "autochthonous" races, which gradually intermingled and, by this blending of powers, gave rise to that superior intelligence which laid the foundation of European culture and assured the predominance of the white race of that continent in the later history of the world. Certain it is that neither he nor any other craniologist has been able to define either any European or any Aryan "type" of skull; and if the general theory of the cranial type is to be saved at all, it must be by some such *ex post facto* hypothesis as this.

The next meeting of the society will be held next August in Hannover.

Ethnology of the Eskimos.

A clear and pleasant account of the Eskimos appears in recent numbers of *Das Ausland*, from the pen of Fridhjof Nansen, the celebrated explorer of Greenland.

From their close similarity wherever found, and from the slight differences in their dialects, he believes them to have developed from some small and homogeneous stem in comparatively recent times and to have spread along the coasts of the icy sea. He expresses some doubt as to whether they occupied the southern extremity of Greenland when it was first discovered by the Northmen. The point from which they spread he believes to have been somewhere on the shores of Behring Sea or Behring Straits. In this he differs from Dr. Rink, who places their earliest assignable abode in the interior of Alaska, and still further from Mr. Murdoch, who, with greater probability, would locate it about Hudson Bay.

Nansen's description of the appearance, habits, and arts of the East Coast Eskimos is both amusing and instructive. He found them, in spite of many nasty habits, attractive in character and of good mental ability — all the better, the less they had been subjected to the influence of European instruction and religion. One of their curious superstitions is that they will not touch their hair, in the care of which they take great pride, with any object made of iron, not even to trim it: This recalls similar objections to that metal in the rites of ancient Rome and Egypt. Physically he describes them as a well-made race, quite of the average European height, the young women sometimes good-looking. The general tone of his article is highly favorable to the stock.

NOTES AND NEWS.

A MEETING was held recently at the State Capitol, Concord, N.H., upon the call of the Forestry Commission, to see what action is desirable toward the preservation of the forests among the mountains, and at the head-waters of the principal rivers. The Appalachian Mountain Club was represented by delegates, prominent citizens of New Hampshire were present, and much interest was manifested. The meeting formulated certain propositions indicating desirable laws to be secured from the incoming Legislature. It is apparent, however, that public discussion is necessary to find out what action is desirable and favorable, and to

arouse public sentiment sufficiently to bring about valuable results. The Boston *Herald* has started a fund to enable the Commissioners to prosecute this work. The Commissioners are all members of the Appalachian Mountain Club: Hon. Joseph B. Walker of Concord, Hon. G. Byron Chandler of Manchester, and Rev. J. B. Harrison of Franklin Falls. The Council of the Club has appropriated $25, and individual members have already subscribed to the *Herald* fund. The Council has appointed a committee, consisting of Rosewell B. Lawrence, 53 State Street, room 518, and Walter R. Davis, 121 Devonshire Street, Boston, to receive contributions from members, the contributions to be used at the discretion of the Council as an addition to the *Herald* fund, or to be expended by the Council itself in connection with the matter of the preservation of the forests.

— At the thirty-sixth annual meeting of the Association of Officers of Colleges in New England, held at Williams College, Nov. 3–5, 1892, it was voted that the following memorandum be furnished to all educational journals for publication, but with the declaration that this action of the association does not commit any college faculty to the recommendations made in the memorandum: The Association of Officers of Colleges in New England, impressed with the real unity of interest and the need of mutual sympathy and help throughout the different grades of public education, invites the attention of the public to the following changes which, without insisting upon details, it recommends for gradual adoption in the programme of New England grammar schools. Art. 1. The introduction of elementary natural history into the earlier years of the programme as a substantial subject, to be taught by demonstrations and practical exercises rather than from books. 2. The introduction of elementary physics into the later years of the programme as a substantial subject, to be taught by the experimental or laboratory method, and to include exact weighing and measuring by the pupils themselves. 3. The introduction of elementary algebra at an age not later than twelve years. 4. The introduction of elementary plane geometry at an age not later than thirteen years. 5. The offering of opportunity to study French, or German, or Latin, or any two of these languages from and after the age of ten years. 6. The increase of attention in all class-room exercises in every study to the correct and facile use of the English language. In order to make room in the programme for these new subjects, the association recommends that the time allotted to arithmetic, geography, and English grammar be reduced to whatever extent may be necessary. The association makes these recommendations in the interest of the public school system as a whole; but most of them are offered more particularly in the interest of those children whose education is not to be continued beyond the grammar school.

— An interesting experiment in naturalization, namely, the transfer of living lobsters (*Homarus vulgaris*) from England to New Zealand, has just been crowned with success. The fitting-up of steamers with refrigerating chambers for the carriage of frozen meat from New Zealand to the Mother Country, has enabled experiments to be carried out, with every prospect of success, which were formerly considered almost impossible of fulfilment. Some years ago humble-bees were by this means successfully carried to the island colony, where they have increased amazingly, and from whence they have since been carried to Australia and Tasmania. Shipments of salmon ova are likewise now made almost without loss. The latest experiment, the carrying out of live lobsters, has also been successfully accomplished. This result is due to Mr. Purvis, chief engineer of the steamship "Ionic," who has taken great interest throughout in this work. An attempt was made last year by the same gentleman, at the instance of the Otago Acclimatization Society, who were aided in their efforts by Mr. John Ewing of London and Dr. Cunningham of the Plymouth Biological Station. The attempt, however, failed almost at the outset. Tanks were constructed on board the steamer, and stocked with lobsters, but within a few days after starting all the crustaceans died. The construction of the tanks was probably faulty. On the last outward trip of the steamer, Mr. Ewing obtained a dozen fine specimens of lobsters, and handed them over to Mr. Purvis, who safely conveyed nine of them to their destination. These animals, four males and five females, were liberated on a rock-built mole at the entrance to Otago Harbor, where they are likely to thrive, and from whence they will no doubt spread widely. The coast-line, both north and south, is rocky, and is eminently suited for crustaceans. At present it is tenanted by a large crayfish (*Palinurus*), and it will be an interesting problem to see how the introduced animal will thrive. The crayfish is strongly armed defensively with a strong carapace and stout spiny prominences on its front, and on the anterior limbs. It is extremely common on the coast. But there are no crustaceans with the formidable chelæ of the lobster, and it will most probably be able to more than hold its own. This first shipment is certain to be followed by others, and it is almost safe to predict that in a few years frozen lobsters will form one of the articles of export from New Zealand.

— The fifth annual meeting of the Geological Society of America will, by invitation of the Logan Club of the Canadian Geological Survey, and the Royal Society of Canada, be held in Ottawa, in the House of Commons building. The society will be called to order at 10 o'clock A.M., Wednesday, Dec. 29. An address of welcome will be given by his Excellency, the Governor-General of Canada, with a response by the president. The headquarters will be at the Russell House.

— The eleventh annual meeting of the American Society of Anatomists will be held on Tuesday, Wednesday, and Thursday, Dec. 27, 28, and 29; the Society of Morphologists will meet on Tuesday and Wednesday morning, Dec. 27 and 28; and the Society of Physiologists will meet on Wednesday, Dec. 28; all at Princeton, N.J. The papers, so far as announced, are: C. Hart Merriam, The Death-Valley Expedition; Reports upon Marine Biological Laboratories; John A. Rider, University of Pennsylvania, The Sea Isle Laboratory; E. A. Andrews, Johns Hopkins University, A Marine Station in Jamaica; D. Bashford Dean, Columbia College, The Marine Laboratories of Europe; C. O. Whitman, University of Chicago, The Outlook for a Marine Observatory at Woods Holl; Endowment of the American Table at Naples, C. W. Stiles; Botanical Explorations in Florida, W. P. Wilson; The Summer Work of the U. S. Fish Commission Schooner "Grampus," William Libbey, Jr.; Expeditions of the American Museum of Natural History into New Mexico, Wyoming, and Dakota, J. L. Wortman; Annual Discussion, What were the Former Areas and Relations of the American Continent, as Determined by Faunal and Floral Distribution? Introduction and Evidences from Past and Present Distribution of Mammals, W. B. Scott; Evidence from Past and Present Distribution of Reptiles, George Baur; Evidence from Distribution of Birds, J. A. Allen; Evidence from Distribution of Plants, N. L. Britton.

— An International Meteorological Congress, to form one of the many scientific gatherings in Chicago next year while the World's Fair is in progress, is in contemplation; and an Advisory Council of the World's Congress Auxiliary, to arrange for the same, has been appointed. It includes the heads of the national weather bureaus, American and foreign, the chiefs of the State services in this country, and a few other men who have been conspicuously identified with weather science. Very appropriately, Professor Mark W. Harrington, chief of the Weather Bureau, has been designated as chairman of this council. The congress will sit during the week beginning Aug. 21, 1893; and the following classification of topics for discussion has been made: (*a*) Instruments and methods of observation; (*b*) theoretical meteorology, including cyclones and secondary storms; (*c*) climatology; (*d*) agricultural and hygienic meteorology; (*e*) marine meteorology; (*f*) government weather service, including weather telegraphy, predictions, verifications, special thunder-storm and other service; (*g*) terrestrial magnetism and atmospheric electricity, including magnetic storms, cosmic-magnetic fields, magnetic and electric instruments, lightning and aurora; (*h*) geologic climate, including the glacial age, quaternary changes in climate, and the testimony of flora and fauna; and (*i*) meteorologic literature.

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SKETCH OF THE FLORA OF DEATH VALLEY, CALIFORNIA.[1]

BY FREDERICK VERNON COVILLE, WASHINGTON, D.C.

SINCE Death Valley, as shown by the published records of the Weather Bureau,[2] is the hottest and dryest area known in the United States, and probably in the world, and since the observations of the Death Valley Expedition showed that these extreme climatic conditions are reflected in its vegetable life, a description of this flora has an interest even greater than that incited by the average desert vegetation.

One not familiar with the Mohave and Colorado deserts must imagine broad stretches of treeless plains, out of which rise abrupt mountains, not covered with trees but exhibiting naked faces of rugged rocks with no covering of soil or lichens to conceal even their coloration. In the northern portion of the Mohave Desert region, in which Death Valley lies, the mountain ranges are closer together and the plain is cut up into narrow deep valleys trending in a general north and south direction. The deepest of these is Death Valley, its length about 175 miles, and its greatest breadth from peak to peak about 20 miles. The lowest portion of the valley is a moist plain about 40 miles long by 2 to 6 miles broad, gleaming with salt and alkali. Between this and the mountain faces are sloping gravelly mesas, at some parts of the valley 6 miles broad, at other points entirely absent. The mountains themselves are abrupt and naked, the Funeral Mountains on the east rising 7,000 feet, the Panamints on the west almost 11,000. Upon the crest of the Panamint range is an evergreen forest of pines and junipers.

The salt-flat in the bottom of the valley is quite devoid of vegetation, not because the moisture in the soil is too scant, but because it is so saturated with salt and alkaline compounds that no plant can live upon it.

The mesa bears a growth of scattered shrubs not sufficient, even at a distance, to conceal the ground between them. No larger plant is to be seen except at certain points where, along the line between the mesa and the salt-flat, the sub-soil is sufficiently moist to support the mesquite. This is a low, almost shrub-like, tree which commonly attains a height of 10 to 15 feet. This characteristic then, the absence of trees, may be taken as the most conspicuous feature of the Death Valley vegetation, as it is of the desert in general.

[1] In January, 1891, an expedition was sent out by the U. S. Department of Agriculture to explore the region of Death Valley, California, and to make a biological survey of it. About nine months were spent in the field, and the report, now nearly completed, will soon be published by the department. The general botanical features of the region, a full discussion of which will constitute a part of the final report, are here described by the botanist of the expedition.

[2] U. S. Department of Agriculture, Weather Bureau Bulletin No. 1, Notes on the Climate and Meteorology of Death Valley, California, by Mark W. Harrington. Washington, 1892.

The mesas bear, besides the shrubs, a large number of herbaceous plants which, although in late summer and in winter dead and barely noticeable, in the spring months of a rainy year come to be in some places really conspicuous. One of the desert sunflowers (*Encelia eriocephala*) was at one point so abundant that it even made the mesa appear yellow, at a distance, over an area many rods in extent. The general impression, however, of the traveller who is not a botanist is that the vegetation of the valley consists of clumps of mesquite set here and there along the edge of the salt flat, and a few scattered greasewood and creosote bushes on the mesa.

Not all parts of the mesa are, however, supplied with even so much plant life. At the mouth of Furnace Creek Cañon is a broad slope composed of mixed gravel, sand, and clay, a matrix capable, in some parts of the desert, of supporting a varied flora; but here for hundreds of yards is seen no plant whatever except one of the smallest greasewoods (*Atriplex hymenelytra*), its individuals growing far apart and attaining the height of barely a foot.

In still other portions of the mesa occurred a phenomenon which, if it is here interpreted rightly, is the best index that we have of the intense heat of this region. The higher portions of the mesa are cut up by the dry channels of the streams that follow mountain cloudbursts. Between these channels, which are called sometimes arroyas but oftener washes, are broad blocks of the mesa, whose surface has lain undisturbed for undoubtedly many thousands of years. The surface of the soil is covered closely with a layer of small, flat, water-worn stones which have accumulated on the top of the ground by the gradual washing out of their original clayey matrix. The erosion of the soil has undoubtedly been brought about by the slow agency of direct rainfall. The upper surfaces of the stones have a dark brown, almost black, color, and the dull lustre of a hard-burned brick. The coloration of these stones is ascribed to binoxide of manganese, produced by oxidation due to intense light acting during long periods of time[3]. These so-called sunburned areas in Death Valley bear no vegetation whatever. Even the two desert annuals, *Chorizanthe rigida* and *Chænactis attenuata*, which grow at other points in the hottest spots, are here wanting. The soil, a firm clayey one, is good, and the surface receives just as much rainfall as other parts of the valley. The phenomenon is explained by no hypothesis except that of intense heat, and a consideration of the evidence, in the absence of direct experiment, indicates that such a cause may be quite sufficient.

Experiments by Sachs upon active protoplasm have shown that when subjected to a temperature of 50° C. (122° F.) it ceases to carry on its functions, disintegration sets in, and death follows. But a plant may be situated in an atmosphere whose temperature is higher than this without itself attaining so great a heat; for two causes tend to reduce its temperature, the non-conductive nature of the tissues themselves, and the evaporation that characterizes transpiration. Yet even these sources of protection may be overridden by a still higher temperature. The well-known retention of vitality in the case of the spores of certain fungi after exposure to a temperature of even 212° F. does not indicate that a desert plant can endure a similar degree, for the protoplasm of the fungus spore is not in a state of activity, but that of a germinating or growing plant is.

The Weather Bureau tables, in the bulletin cited above, show five records of a temperature of 122° F. This is the temperature of air sheltered from the effects of radiation. The temperature of air exposed to ordinary conditions of radiation must be somewhat higher than this, and the temperature of gravel pebbles on the surface of the ground still higher; but, according to the principles of molecular physics, the black stones that have been described should reach a degree of heat decidedly greater than either of the other bodies. It is confidently believed that a temperature of from 140° to 150° F. is frequently attained under these conditions, and in such a temperature a growing plant would undoubtedly perish from heat.

That the flora of the valley may be more readily considered, all the species observed there have been arranged in groups. A review of these groups suggests some of the leading characteristics

[3] See Annual Report of the Wheeler Survey for 1876, pp. 176, 178.

of the flora. The whole number of species is 186. The group of paludose plants contains 48 names, of which 2 are trees, 6 shrubs, 82 perennials, and 8 annuals. These plants are not representative of the true arid flora of the valley, for they have in most cases an abundant supply of water. Comparatively few of these species are confined to the desert, many of them occur in the humid regions of intramontane California, several extend quite across the southern United States and Mexico, and a few are found throughout the subtropical region of the world. It is a general law, of which this part of the Death Valley flora is but a single example, that aquatic and paludose plants do not follow those laws of distribution which govern a true terrestrial flora.

The second group of plants constitutes the arid flora of the region. Of trees there are none, shrubs 20, perennials 18, and of annuals 50. Fourteen of the perennials are suffrutescent at base and carry on the functions of life throughout the year above ground. Three of the remaining four are grasses, the stems of which also retain some vitality through the winter. One plant only, *Cucurbita palmata*, is a true perennial, but it does not grow in the very arid parts of the valley, and comes almost in the category of moist-soil plants. Functionally, therefore, the arid flora of Death Valley is made up of shrubs and annuals. The reason for this state of affairs is found in the extreme heat and dryness of the climate, these being the two, or we may almost say the only, types of vegetation adapted to such conditions.

The geographic affinity of the arid flora of Death Valley is clear. A few species, such as *Mentzelia reflexa* and *Oxystylis lutea*, are known only in the immediate vicinity of the valley, but nearly all the others are common to the desert region of south-eastern California, Arizona, and north-western Mexico. The topographic position of Death Valley, as the deepest basin (480 feet below sea-level) in this desert area, renders the valley capable of supporting a vegetation belonging characteristically to the southern portion of the region. Several southern species, so far as the present data show, reach their northern limit in Death Valley.

The adaptive modifications of the flora are practically the same as those of the general vegetation of the surrounding desert, and will be discussed in considerable detail in the report of the expedition.

NOCTURNAL SONGSTERS, AND OTHER BIRD-NOTES.

BY ROBERT RIDGWAY, M.S., CURATOR OF THE DEPARTMENT OF BIRDS, U. S. NATIONAL MUSEUM.

DR. GIBBS'S interesting article on birds that sing in the night, in *Science* for Dec. 2, reminds me that much may yet be written on this subject. Some of our best songsters are unfortunately not represented in that portion of the country (Michigan) of which Dr. Gibbs writes; otherwise, his list of night-singers would not only have been considerably longer, but would have included at least two species, the mocking-bird and the yellow-breasted chat, that are every whit as notable as the nightingale itself. The night-singing habit of the mocking-bird is well known to all who are familiar with this "master of song." It is as much a characteristic of the bird as its powers of mimicry, for not all mocking-birds mimic, of which, however, more presently.

Next to the mocking-bird in this regard, though perhaps it would be better said equally with it, is the yellow-breasted chat, a bird remarkable for the oddity of its song rather than for its musical quality. Its notes are, however, loud and emphatic, and therefore are sure to attract attention whenever heard at night-time. Its nocturnal song — in no respect that I can discover different from that which it sings by day — has been familiar to me from boyhood, first in southern Illinois, then in California and other far-western States, latterly in Maryland and Virginia. A pair of chats live during summer close by my home (in a suburb of Washington), and few are the nights in May and June when the male does not sing, at more or less frequent intervals, the whole night through. I once thought that moonlight nights were particularly apt to excite birds to sing; but this particular chat kept no account of the almanac. His most brilliant performance, or at least the occasion which most compelled my interest, was during a specially dark night, when I purposely kept awake to make observations. From the time that darkness settled until 3 o'clock in the morning (when I shortly fell asleep) the longest interval between his songs was twenty minutes, but during the greater portion of the night he had scarcely finished one performance than another was begun.

Several others of our birds may properly be termed "habitual" night-singers. Here, about my home, I hear every night during the nesting season (unless it be storming) songs of the chipping sparrow, the field sparrow, the indigo bird, and the golden-crowned thrush, or oven bird; not merely once, but repeatedly. The night-song of the last-named bird is quite the same as that which John Burroughs says is the love-song; but I am puzzled to know whether at night, in the darkness, the singer launches from his high perch into the air, as is his habit during the waning light of daytime. I have heard the night-song of the oven bird so often and been so impressed with its exquisite though transient beauty, that I feel sure Burroughs was right when he suggested that Thoreau's "mysterious night-warbler" was really no new bird at all, but one he was otherwise familiar with; in short, was none other than the oven bird. Speaking of Burroughs, recalls an erroneous statement in one of his charming books ("Birds and Poets," p. 98). He says: "No bird can look our winters in the face and sing, as do many of the English birds." Surely had he passed a winter south of the parallel of 40° in the United States he could hardly have made this assertion. Here about Washington, and westward to beyond the Mississippi, the Carolina wren sings the winter long; and the colder, more crisp, the weather, if only the wind does not blow, the louder rings his powerful carol. So, also, does the tufted titmouse heed not the cold of winter, but bravely whistles his cheery tune of *pé to, pé to, pé to* — some would not call it a song, but it is loud and clear enough, and surely is no mere call-note. The cardinal, too, sings more or less all winter, and so do the white-throated and tree sparrows, though there are periods, caused doubtless by meteorological conditions, to us intangible, but of which the birds take note, when birds are little heard.

Among the many myths of popular bird-lore is that of the mocking-birds' habit of mimicry, of which a hint was given in a previous paragraph. In making this statement I would emphasize the word *habit*, as distinguished from the term faculty; since I would not for a moment deny this bird's ability (as a rule) to mimic far better than any other. The point is, that mimicry is not so much a habit of the mocking-bird as most people suppose. The reason for the popular error is very simple: The natural song of the mocking-bird is so varied, and is characterized by such wonderful compass, rapidity of change, and brilliancy of execution that persons not specially familiar with birds' notes naturally suppose the medley to be in large part borrowed; and the listener is further confirmed in this belief by the more or less frequent interpolation of what he recognizes as unquestionable imitations of the notes of other birds. Individual mocking-birds differ greatly in the character and quality of their songs, some being inveterate mimics while others seldom if ever spoil their own incomparable song by imitation. I recently possessed one of the best songsters of this species it was ever my pleasure to hear. His song was wholly his own; almost infinitely varied, wonderfully mellow and clear, bewildering in the rapidity of its changes, and surpassingly brilliant in execution. Yet, with all this, if any one of his notes suggested the note of any other bird I am sure it was not intentional.

Not only do birds' songs differ materially according to the individual, but often each individual possesses a more or less extensive *repertoire*, the separate parts or tunes of which are so different from one another that, heard without the singer being seen, they might readily be attributed to different birds. This is particularly true of the cardinal grosbeak; and I have not the slightest doubt some observers have received an unfavorable impression of this bird's song from having first, or perhaps only, heard one of the less attractive tunes of an individual which half an hour later might be singing a song totally different, and far finer. A pet cardinal, which I had for several years, sang six very distinct songs, besides minor variations. A remarkable peculiarity of this bird (though one which I believe to be characteristic of the species)

was that one of these songs was almost invariably repeated until he himself became tired of it before he changed to another.

The difficulty of expressing a bird's notes by words is well known, but the following attempt may give some idea of the different songs of my cardinal: —

I. *Hoit,— whoit, whoit, whoit* (eleven times); *hoit,— whoit, whoit, whoit* (eleven times).

II. *Wheù, wheù, wheù, wheù, wheù.*

III. *Tchew, tchew, tchew, tchew, tchew.*

IV. *Bird'ie, bird'ie, bird'ie,— tchew, tchew, tchew, tchew.*

V. *Bird'ie,— bird'ie, bird'ie, bird'ie, bird'ie, bird'ie.*

VI. *Whoy'it, — whoy'it, whoy'et, whoy'et, chichichichichichi* (a jingling trill, so long continued that it apparently ended only when the singer became "out of breath").

The notes of many cardinal grosbeaks are clear and tender — far sweeter than the mellowest notes of fife or flageolet.

One of my most welcome bird-guests last summer was a summer tanager, whose favorite singing station was the summit of a tall scrub pine-tree in a corner of my yard. All day long, from May till August, no matter how hot the sun, he sang, robin-like, this song: *Ter-whit'-ter-way*,— BRING *him* HERE; *ter-whit'-ter-way*,— BRING *him* HERE (repeated incessantly, with very strong emphasis and rising inflection on the "here"). Another male of the same species, whose nest was in a neighboring pine grove, answered thus: BRING-*him*-HERE, *chip'-way*, BRING-*him*-HERE, BRING-*him*-HERE.

This beautiful tanager and the red-eyed virio are midsummer and midday songsters. Perhaps it is because they are representatives of tropical families that they do not mind the intense heat of the dog-days, but sing cheerily, the former from the tip-top of some tree taller than those about it, his glowing red plumage receiving, it may be, increased refulgence from the burning rays of the sun, the latter, of modest olive-green and whitish garb, as he busily gleans his insect food among the shady leafage of the forest trees.

The subject of midday songsters brings me again to John Burroughs, who, always charming and usually accurate in his descriptions of bird-life, sometimes (like the rest of us) makes mistakes. The bird involved is the grass finch, for which he prefers the name vesper sparrow (since adopted by the American Ornithologists' Union), and all he says of it is true and eminently characteristic except the statement that "his song is most noticeable after sundown, when other birds are silent,"— which does not accord with my own experience in midland Virginia, where, in extensive fields of a large farm, numbers were heard singing sweetly through the hottest part of the hottest day of a hot summer,— the time being about 1 o'clock P.M., the date July 4, 1887, and the temperature 103° in the shade!

But the habits of birds do vary, and one day's observations, in the same locality, may quite contradict those of a previous occasion; therefore, only repeated observations, under varying circumstances of time and place, can give us an approximately correct knowledge of the habits of any species.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

How are Young Spiders Fed?

IN my rambles for botanical specimens in the last three years, many new and curious things have been thrust upon my attention in the insect world, and these I have recorded for future use. One fact in particular struck my attention, and I herewith submit it to the readers of *Science*, partly to record the fact, and partly to ask if any other readers of your excellent periodical have ever observed a similar fact.

We have been taught by the best works on spiders that the young of spiders derive their food mostly from the atmosphere. The "Encyclopædia Britannica" confirms this view.

On the 19th day of June, 1891, I discovered, in a ploughed field, an enormous spider of the *Lycosidæ* species, which was 1¼ inches long. She presented a very curious appearance, being covered with scores of tiny spiders from one end of her body to the other. When I touched her with a weed-stem the young spiders scampered off at a lively rate, only to return when left to themselves. The spinnarets and abdomen of the mother-spider were greatly distended. Suddenly, there was a copious flow of white liquid which the young greedily devoured. Examining the fluid under my microscope, I was fully convinced that this was veritable milk, and that this spider, at least, nursed her young, instead of bringing them up on atmospheric moisture. I should be glad to know if any readers of *Science* have ever observed a similar occurrence. JOHN W. SANBORN.

Naples, N.Y.

Palæolithic Man: A Last Word.

THE world was growing old apace, just as it is now, when Man first entered upon the scene here in the valley of the Delaware. Over the hills and along every lowland water-course forests grew, died, fell, and decayed, helping to make that deep deposit of soil which now covers the gravel and sand that agencies no longer active had spread over the surface of the land. Just what was the outlook that presented itself when the first Man or Men looked about them, we can only conjecture. Mr. McGee claims that the evidence favors the view that the soil had formed, the forests were old, pines had succeeded oaks, and oaks succeeded pines, and the elk, deer, and bear were the chief sources of food-supply to the wandering hunter that, reaching out from his native land, came, saw, and conquered the valley of the Delaware. But is this true? Has he or has any one so carefully studied the soil-making period that all doubt is dissipated and shown that the Indian of historic time can only trace his ancestry back to so recent a time as when the brute creation that still lingers on our frontiers was its sole occupant? If the reader, curious in such matters, will look into the literature of this subject, he will find that the evidence has been produced time and again to show that with the very commencement of this soil-making period, are so intimately associated abundant traces of a tool-making creature — a man — and in such a manner associated, that the suggestion that all such objects of human origin are "intrusive," has no real weight.

Sections of undisturbed soil, sand, and gravel are not difficult to make and when we find that as a result of a large series of such, we have a uniform result, we are bound, if reasonable men, to accept such as the truth. Now this has been done, as I have said, and the fact obtained that relics of man of a very rude character underlie those of a more elaborate one. In an earlier publication I have ventured to call the former "fossil implements" and the later ones "Indian relics;" although, of course, they were all made, I believe, by the same people, but at different times. The apparent contradiction that rude and elaborate alike are found on the disturbed surface has no bearing upon the question. What the plow or spade has displaced has no longer an archæological significance, save as to its import as a tool or weapon of a particular character. A stone axe is an axe wherever and however found, but if it has been tossed about the fields or washed by a freshet from its original resting-place, what more can we say than that it is an axe? On the other hand, if in a section through the soil and underlying sand we find rude argillite implements and the very rudest pottery, and above them, *wholly in the soil*, axes, celts, pipes, and pottery of more artistic finish; find this not once, but always; then we have the right to, indeed cannot honestly do otherwise, assert that the deeper, sand-encompassed objects antedate those which occur only in the over-lying soil. This holds good in archæological research in any part of the world, and is just as true as that in building a city to-day, we are building upon the ruins of an Indian village, or at least on ground where once the Indian passed and re-passed, even if he did not tarry long.

But can we go back a step farther? If we can do so elsewhere on the globe, I hold that it is warranted to do so here and for the same reasons. The geologists to effectively prevent this must show that the earth previously was uninhabitable; that the phy-

sical conditions, the climate, the fauna and flora alike forbid it, and this has not been done. Man lives in less hospitable regions now than when the Trenton gravel was laid down; the climate at the close of the glacial period was not more severe than that obtaining to-day in the Arctic circle. The reindeer, musk-ox, seal, and walrus sustain man to-day in Arctic America, and why should they not have done so in the Delaware valley, when a prominent feature of this fauna, as their bones in the gravel testify, they once were? There is an Arctic flora in existence now; so why not here in the distant long-ago of Glacial times; and forests, we know, can flourish at the very edge of a glacier.

This whole matter is not so exclusively a geological question as the votaries of that science declare. The archæologist has this surface soil and the sand and gravel beneath it clearly within the range of his domain, and he is no archæologist whose training falls short of ability to study intelligently the history of these superficial deposits.

As yet, concerning the gravel deposits of the Delaware valley, the geologists have merely put in a denial, which should not weigh against the careful researches of those who have given years to the study of this subject. What is needed in these overcrowded latter days is a proof that palæolithic man is an impossibility. When this is forthcoming, and not until then, will the student of early man in America haul down his flag.

As to the present controversy, here is the whole matter in a nutshell:—

I.

The stones are inspected,
And Holmes cries "rejected,
They're nothing but Indian chips"
He glanced at the ground,
Truth, fancied he found,
And homeward to Washington skips.

II.

They got there by chance
He saw at a glance
And turned up his nose at the series;
"They've no other history,
I've solved the whole mystery,
And to argue the point only wearies."

III.

But the gravel *is* old,
At least, so I'm told;
"Halt, halt!" cries out W. J.,
"It may be very recent,
And it isn't quite decent,
For me not to have my own way."

IV.

So dear W. J.
There is no more to say,
Because you will never agree
That anything's truth
But what issues, forsooth,
From Holmes or the brain of McGee.

CHARLES C. ABBOTT, M.D.

Water Rattlesnake in Captivity.

IN your issue of Nov. 11, there was an interesting account by R. W. Jones of a rattlesnake that would not eat. I had the care, this year, of a water rattlesnake (*Crotalus adamanteus*), which, after some trouble, I persuaded to eat. It was sent from Florida to the Toronto Natural History Society, in September, 1891; and at first we intended to put him in a cellar for the winter, and let him hibernate; but I thought a warmer place would be more likely to suit him, and so leave was obtained from the authorities to keep him in a large conservatory at the horticultural gardens. He had a glass-sided case to live in, 8 feet long and 15 inches wide, and was himself about 3 feet long.

I put a bull-frog in with him one day, but he took no notice of it, beyond just touching it with the tip (or tips, to be quite correct) of his tongue. I then tried him with a brown rat (he had now been about three months without food); when he saw the rat he grew quite excited, and struck at him twice. I waited about half an hour, expecting the rat to die, but the bite seemed to have no effect, so I left the rat in the case. As this was a Saturday, I did not see him again until Monday, and I then found the rat still alive; but with a bad bite on the side of its head, and the snake had two holes, made by the rat's teeth, through its rattle. The gardener told me that they had a fierce battle on Sunday afternoon, but they now seemed each afraid of the other. I killed the rat, and left the body in the snake's case, but he would not eat it. I next put a white mouse in his case, but of this he took hardly any notice. About the end of March I shot two goldfinches, and placed the dead bodies in his case. On visiting him again in a day or so, I was delighted to find that one of the goldfinches had disappeared. After this I supplied him frequently with dead birds, and about once a month he condescended to eat; but the birds he eat were always small ones, such as goldfinches, chipping sparrows, and warblers; he never ate any as large as the English sparrow or purple finch, several of which I put in his case; and he never fed while any one was looking at him.

His rattle was permanently injured by the rat's attack, and ever after sounded only a feeble and subdued kind of alarm. He changed his skin once during the summer; and, after the change, the tints of the beautiful diamond pattern on his back were extremely bright and vivid.

I could not get him to feed at all after the beginning of August, and he died in October, 1892, having been in captivity for a little over a year, for the first six months of which he went entirely without food. I gave him a shower-bath occasionally, which he seemed to enjoy, and was, I think, more ready to feed after he had been well moistened in this way.

I have now another and larger specimen of this rattlesnake to take care of. It was received from Florida in October last, and is quartered for the winter in a very warm and comfortable green-house. He has not as yet eaten anything, but I may be able to send you, next year, some report as to how he behaves.

I. B. WILLIAMS.

Toronto, December.

Intelligence in the Lower Orders.

SOMETHING over a year since a young lady of my acquaintance had an experience with a beetle, which, I think, showed a very marked degree of intelligence in the insect; and, as such instances are somewhat rare, I venture to send you an account of it.

This beetle was a specimen of *Pelidnota punctata* Linn., which was given to her in September. At first she kept it in a small box, feeding it with grass, leaves, and small pieces of fruits, such as peaches, pears, etc. Occasionally she would give it a drop of water to sip. It would sometimes bite a little out of a leaf, would eat the fruits, and would take water eagerly.

From the first she would take the insect in her fingers several times a day and stroke or caress it, also putting it to her lips and talking to it all the while she handled it. When she put it to her lips it would brush its antennæ over them with a gentle, caressing motion.

When she left her room she would shut the "buggie" up in its box. One day, about two weeks after she received it, she was called out suddenly and neglected this precaution. She was absent a considerable length of time, and when she returned the insect was not in its box nor anywhere to be seen. Fearing that she might injure it, she stood still and called "buggie, buggie," when it came crawling from its retreat toward her.

After this, she would frequently leave it free in the room when she went out, and when she returned, if the insect was not in sight, she would call it, and it would crawl or fly to her. As this was continued, it would more and more frequently fly to her instead of crawling, until at last it flew nearly every time it was called. When it came in this way, she would put it to her lips or to her nose, and the insect would appear to be pleased, moving its antennæ gently over her lips, or taking the end of her nose between them and touching it with a patting motion.

She kept it in her room in this way, at the hotel where she was spending the summer, until about the first of November. She then returned to her home some three hundred miles further south, taking the insect with her. Here she at first kept it in her chamber, but the nights being sometimes very cool, it would become torpid and not get lively again until afternoon. Thinking it too cool for "buggie" there, she removed it to the kitchen. As it still appeared more or less dormant, she put it on a cloth above the hot-water boiler. Here it revived somewhat, but was not very lively nor did it eat very much.

About the middle of December it fell to the floor accidentally, by which fall it was evidently injured, as after that time it would eat nothing, and no longer recognized the young lady. About a week later it died. B.

Meteoric Shower.

THE well-known stream of meteors — the Andromedes or Bielids — overtook the earth on Wednesday, Nov. 23, 1892. At this observatory they were seen soon after sunset, and the fall was continued at a uniform rate until eleven hours, when their number in a given time was diminished by half. The display was at a maximum of magnificence between the hours of nine and ten. From 9 to 9.16, one hundred fell; from 9.35 to 9.46, one hundred; from 10.18 to 10.26, one hundred; and this rate was maintained nearly all the evening. Likely, three-fourths of all that came were seen, since the eye was held steadily on the radiant, which was in Andromeda, not far from Brooks's comet. Of course, the meteors were not connected with that body. The highest number seen at once was six, and they seemed to emerge from the same point. Two were almost as brilliant as Jupiter, and left trains. Perhaps one-tenth of all seen had trails. Their velocity was not great, as this stream overtakes the earth, instead of meeting it.

EDGAR L. LARKIN.

Knox College Observatory, Galesburg, Ill.

Pseudoaurora.

IN *Science* for Dec. 2 (p. 318) there is an interesting note regarding a peculiar appearance simulating the aurora around electric lights in Minneapolis. The writer approached the city from the suburbs and noticed nothing till he had passed the gas lights, but as he approached an electric light he saw beams emanating from it, and these disappeared on passing the light. The air was full of frost particles, giving an appearance of light fog. These appearances were simply shadows cast upon the fog by projecting arms or objects in the beam from the light and had no connection with electricity. These rays may be seen at any time when there is smoke, light fog, or mist. The easiest way to see them is to stand directly under the light and look up. Another way is to approach the light from a distance of 300 feet with the iron support of the lamp hiding the bright light from the eye. Any little opacity in the globe will throw a shadow into the fog. Oftentimes these rays are very beautiful, especially when seen through the branches of a tree.

These shadows are really the same as the Brocken Spectre, about which so much has been written. See this journal for Sept. 27, 1889, for an explanation of the phenomenon. Also *American Meteorological Journal*, March, 1890, p. 515.

H. A. HAZEN.

Washington, D.C., Sept. 10.

Brilliant Meteor.

ON the night of Nov. 29, about 8 o'clock, a very large meteor was seen passing westward, a little to the south of this place. Just as it seemed to be passing the body exploded, producing a sound that was distinctly heard, resembling that of a rocket explosion or a pistol-shot. After the explosion a body half as large as a full moon moved away to the westward, making a hissing, or frying sound. I have seen no one who saw the meteor before the explosion. The whole country was brilliantly lighted for a moment as if by a continued electric discharge, but at the time of the explosion the light was red and blue, or perhaps violet. The sound of the explosion was heard by parties five miles west and seven miles east of here, who could not have been less than ten miles apart on an air-line, and they report the sound together with the other phenomena to have been about the same as they were here. I have no reliable reports from any greater distance than that. But this indicates that the body must have been of considerable size, and at a considerable distance from the earth.

C. F. MAXWELL.

Dublin, Tex., Dec. 1.

Ink-Stains.

To remove bad ink-stains from white linen (shirts, table-linen, etc.) place the stained part in Sabarraque's Solution, leaving the article in the solution until the linen is white. This must be used only for white goods. After a short time in the solution the ink-stain will gradually take on a copper color, gradually fading to a greenish hue, and finally nearly white. Washing in cold rain-water will finish. I believe this to be new.

A. M. WHITON, M.D.

Brockport, N.Y., Dec. 8.

BOOK-REVIEWS.

Eleventh Annual Report of the U. S. Geological Survey, 1889–1890. Part II. *Irrigation.* Washington, 1891. xiv., 395 p. Pl. 30. Fig. 4.

Irrigation and Water-Storage in the Arid Regions. By GEN. A. W. GREELY. Washington, 1891. 356 p. Pl. 37.

Final Report of the Artesian and Underflow Investigation and of the Irrigation Inquiry, Made under the Direction of the U. S. Department of Agriculture. Washington, 1892. Parts 1, 2, 3, 4. Many Plates and Maps. 52d Congress, First Session. Sen. Ex. Doc., No. 41.

Census Bulletins on Irrigation. Arizona, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Artesian Wells for Irrigation. By F. H. NEWELL. Washington, 1891–1892.

Extra Census Bulletin, No. 23. *Agriculture. — Irrigation.* By F. H. NEWELL. Washington, Sept. 9, 1892.

THE subject of irrigation has of late years assumed an importance that it has long merited but has not received. If that man be a benefactor of the human race who makes two blades of grass grow where one grew before, how much more a benefactor was he who first drew from creek or river the waters the heavens refused to bestow, and who thus became tenfold, yes, a thousandfold, a human benefactor! Unfortunately, his name, his birth, his lineage, are all unknown, for the process of irrigation under one form or another has been practised since the earliest time of which there is any historic record. Perhaps the idea originated in those countries where rivers overflow their banks periodically, and where a certain definite time in the year may be considered to bring the flood. Be that as it may, in Egypt, in India, in China, irrigation has been a practice for many thousand years, and in these countries is now more extensively in vogue than ever before. It is not only in civilized and semi-civilized communities that irrigation is found, but in savage ones also, for recent travellers have noted the presence of irrigating ditches among certain African tribes, which, while not savage in the worse sense of the word, have still not yet reached the platform upon which semi-civilized races are assumed to stand.

In these older, eastern countries, irrigation is thus of very great antiquity. In the newer ones of the western and southern hemispheres, while of far less age, it cannot be said to be of any less importance. The Australian colonies have done a wonderful amount of irrigation engineering, this being necessary by reason of the peculiar climatic conditions and their vast tracts of otherwise unproductive territory. The work, too, being under government auspices, is of a more gigantic character than in any of the newer countries using irrigation. Of these our own country is not the least. In our western territory, while there are vast areas that can never be brought under the dominion of the plow and harrow, there are almost equally vast ones that will be gardens

in that time when the vivifying touch of water shall have reached them. Even now in California, Arizona, Utah, Colorado, and other western States, the subject of irrigation is a dominant one; and, as it is so vitally concerned with the growth and prosperity of the people, the general government has taken hold of it in certain ways. The titles which head this article are some of the more recent publications concerning this great question. They are by no means all that have appeared, but from a mere glance at them one may glean an idea of the extent and importance of the work.

The portion of the Eleventh Annual Report of the U. S. Geological Survey, which deals with irrigation, is a comprehensive document, full of valuable information. It is enriched by three maps of the arid region of the United States, and upon which are plotted the areas under irrigation, the forestal areas, and the drainage areas. It may be well to say that the arid region, as defined by the report, is all the country lying between the 100th meridian on the east, and the irregular line formed by the Sierra Nevada mountains, as far south as the 87th parallel and the Pacific Ocean south of it, on the west. Over this vast area there are scattered tracts of greater or less extent that are now being irrigated. Tracts that without water would never be able to support any but a scanty population; but that with it, will be and are the homes of thousands.

The report details the scope of the work undertaken, and describes the methods by which it was carried on. The means of measuring the volume of water discharged by different streams, the measurements of rainfall, the amount of evaporation from river or lake surfaces, and finally the hydrography of the drainage basins. are all treated in full. The latter is especially complete, for we have here accounts of the Yellowstone, the Missouri, the Arkansas, the Rio Grande, the Gila, the Truckie, the Carson, the Salt Lake, and the Snake River basins. There are also tables of monthly discharges of many large and small streams, and tables of gaugings at various stations. Under the head of "Engineering" are given details of the work of various field-parties. Then comes a statement of the director of the survey, to a House committee on irrigation, in regard to the arid lands. In the course of this the situation and extent of forests, the general physiography of the district, artesian irrigation, conditions affecting the artesian water-supply, the limit of utilization of artesian water are discussed; many tables of statistics concerning wells are given, followed by a general consideration of the geological conditions affecting the supply. The last paper is a bibliography of irrigation literature, embracing many titles, but not claiming to be in any way complete. This, in brief, is an outline of the contents of the second annual report of the irrigation survey, during the course of which over $235,000 was expended.

The second title mentioned contains mainly tables of temperature and rainfall for Arizona, New Mexico, Utah, Nevada, California. and Colorado. It is prefaced by a report on the climatology of the arid region by General Greely, in which are discussed the general features of rainfall over the area. In several appendices by Lieut. W. A. Glassford are given accounts of the climatic conditions of the States and Territories dealt with in the report, which will prove of value to the inhabitants of the respective regions. It is not possible to refer in detail to all the interesting features of these reports. We cannot forbear quoting the introductory paragraph to the account of California and Nevada, as it shows the value already attached to irrigation in places where it has been used. It may be well to say, however, that these remarks do not apply to all parts of the State, inasmuch as the rainfall in the north-western portion is normally as great as in many parts of the country where irrigation is never practised. Lieutenant Glassford says: —

"Irrigation does not present itself to the Californian farmer and capitalist as a mere experiment, as a problem whose solution demands the risk of any loss of time or labor, as a thing to be cautiously considered and timorously adventured. Here is a State in which all are agreed that the irrigating ditch is the life of the valley, and the only point which at all needs determination is the amount of water available. Here has developed an agricultural population who look upon rainless skies not as a curse, but as the best gift of nature, since they have themselves a control over the weather beyond the reach of men elsewhere. In 40 years the flume of the miner has grown into the ditch of the farmer, and brings to light more wealth now than when its stream was directed upon the auriferous gravels. In these 40 years irrigation has extended until it may now be clearly seen to approximate that condition in which all the water available is put to use upon the soil, and no more can be obtained. The limit is in sight even though it has not quite been reached, the limit of water which may be drawn from streams by gravity ditches. The future must deal with other sources of supply and other means of utilizing existing sources."

The third title, the final report of the irrigation commission or the "Artesian and Underflow Investigations" of the Department of Agriculture, is of a miscellaneous character, but contains much valuable information. A very limited edition only was printed, and it is probably not to be found in many other than public libraries and those of congressmen. The first part, by R. J. Hinton, special agent, deals with the subject in a general way, considering the progress made in America in irrigation works as compared with other countries, its value for fruit culture, and the progress of irrigation in the States and Territories of the great plains region and the Pacific slope. Part 2, by E. S. Nettleton, consists mainly of profiles and maps, but also contains remarks upon underground and artesian water-supply of the eastern portion of the plains, largely in the two Dakotas. Part 3, probably the most important of all, contains the reports of the geologists. The object of this division of the investigation was to ascertain "the source, volume, and availability of the underground waters of most of the area of the great plains." Professor Hay's field was between the 97th meridian and the Rocky Mountain foot-hills. He explains the geological structure, topography, and water-supply of the region, and then devotes considerable attention to the artesian wells of the Dakotas, examining into and describing the geological structure of the country where wells are now found or where they may be successfully sunk in the future. The portion of territory covered by the report of Professor R. T. Hill is in Texas, eastern New Mexico, and Indian Territory west of the 97th meridian. In his general discussion of underground waters, he shows their existence to be dependent upon geological structure, and explains in a lucid way why this is so. Topography, has, of course, much to do with it, but topography is really dependent upon geological structure. There is little likelihood of obtaining artesian water in mountain regions, because of the highly metamorphosed condition of the rocks, and the (generally) great inclination of the strata. On the contrary, he says, "the most favorable and usual condition for artesian wells is that of strata inclined slightly at an almost imperceptible angle with the surface slope. This condition prevails in gently sloping basins and not in mountains." It is by bearing this principle in mind that successful search for artesian water may be conducted, although, of course, all gently sloping plains are not equally likely to retain surface water to give it out eventually as artesian.

Many details of geological structure of the different regions investigated by Professor Hill are given. They are too numerous to be mentioned here. The author's familiarity with the Texas and Indian Territory country enables him to present its geological features with great clearness. This is especially the case with the Grand Prairie region. The water conditions here consist of (1) rivers, (2) springs, (3) artesian wells. Of these the most interesting and remarkable are the springs. One of the largest groups is a few miles from the city of San Antonio. It forms the head of the San Antonio River, and flows at a rate of 23,000 gallons per minute, or 50,000,000 gallons per day, forming a lake or natural reservoir near the city, and furnishing the 48,000 inhabitants with water without any appreciable decrease in the flow of the river. Another group is near Del Rio, on the edge of the Edward's Plateau, about five miles from the Rio Grande. Of this Professor Hill says: "From the deep-seated rock at its bottom the water can be seen welling up in a great column, and it has the same peculiar greenish blue of the other streams of this class. No live oaks or other trees surround it, and it stands alone, a great fountain in the desert." These springs occur at intervals

along a line 400 miles in length. "They do not break out from bluffs or fall in cascades, but appear as pools, often in the level prairie. . . . The pools are carpeted with exquisite water-plants, forming a waving mass in which may be seen many fishes. So transparent and crystalline are these waters, that objects 15 to 20 feet below the surface appear only a foot away. No tint of surface *débris* or of storm sediment mars the crystal clearness, for they are purified by rising through nature's filter, a thousand feet of the earth's strata." These are natural artesian wells, the water being forced from the ground by hydrostatic pressure acting from many miles away. In his summing-up of the Grand Prairie, Professor Hill remarks: "I drove during the great drought of 1877 from Decatur to Fort Worth [about 50 miles] over a rich, grass-clad region, without being able to secure a drop of water for myself or team the entire distance, while dozens of suffering teamsters were begging and trying to buy water from the owners of the few and all but exhausted surface wells along the way. With the knowledge now before us, every foot of that vast area of the Grand Prairie, being underlaid by water, could be cut into 40-acre tracts, upon each of which, if flowing water could not be obtained, magnificent negative wells rising nearly to the surface could be obtained, furnishing an abundance of waters unaffected by drought."

The "red beds" of Oklahoma, Texas, and New Mexico occupy an area of about 100,000 square miles and receive their name from the color of the rocks, "glaring vermilion or deep-brown chocolate sometimes prevailing, varied only here and there by a bed of snow-white gypsum." The principal area is about 350 miles long by an average of 150 miles wide. The whole series is considered to be "probably a single unbroken formation, representing the sediments of an ancient inland sea." This country is not favorable for the finding of artesian water, although a few surface wells occur at intervals. The Llano Estacado is a plain of about 50,000 square miles area, nearly level, unbroken by trees or bushes, and unseamed by water-channels. Its name is from the Spanish, meaning a wall or palisade, and is derived from the fact that there is a steep and abrupt declivity on all sides but that toward the south-east. It is practically without surface water, there being only a single running stream throughout its whole extent, and this has a length of only about 10 miles, when it is swallowed up in the earth. The cause is found in the porosity of the soil which allows the rain to soak into it immediately. This circumstance, however, is favorable for securing water by wells, and accordingly it is found that wherever they have been dug, water has been found. With water upon its surface, the sterile character of the great Llano will soon be a thing of the past.

We cannot go further into the details of Professor Hill's report here, but must content ourselves with saying that it is to be hoped it may be published in some more accessible form than in a government document that is limited to an edition of less than 1,500 copies.

The report of Professor L. E. Hicks deals mainly with the conditions in Nebraska, and we have an account of the geological structure of the State as related to underground waters. He also considers the irrigable lands and gives an interesting account of the Loup Valley, which lies on the borders of the humid and the arid regions, where rainfall is sometimes abundant and again scanty. It becomes, therefore, a matter of great practical moment to ascertain the possibility of irrigating the land. This can only be done in the valleys, the rest of the country being cut and scarred in a peculiar and intricate way. The capacity of the Loup River for irrigation is limited to about 1,000,000 acres of land, and, as it happens, this is also the amount of land that is capable of irrigation. The last report in the volume is by Professor G. E. Culver, who treats of the artesian wells of the Dakotas.

Part IV. of this report is by J. M. Gregory and F. F. B. Coffin. The part written by the former is general in its character and treats of the conditions in western Nebraska, Kansas, and Okla-

Publications Received at Editor's Office.

ANDREWS, EDMUND AND ANDREWS, E. W. Rectal and Anal Surgery. 3d ed. Chicago, W. T. Keener. 164 p. 8°.
BROWN, J. C. People of Finland in Archaic Times. London, Kegan Paul, Trench, Trubner & Co. 290 p. 12°.
CROTHERS, SAMUEL MCCHORD. Members of One Body. Boston, Geo. H. Ellis. 182 p. 12°. 75 cts.
FOOTE, HENRY W. The Insight of Faith. Boston, Geo. H. Ellis. 115 p. 24°. 50 cts.
HINCKLEY, F. A. Afterglow. Boston, Geo. H. Ellis. 81 p. 24°. 50 cts.
HOPKINSON, John. Original Papers on Dynamo Machinery and Allied Subjects. New York, W. J. Johnston Co. 249 p. 12°.
HOUSTON, E. J. Electricity and Magnetism, being a Series of Advanced Primers of Electricity. New York, W. J. Johnston Co. 306 p. 12°.
JAMIESON, ANDREW. Applied Mechanics. Philadelphia, Lippincott. 268 p. 12°. $1 25.
LYDSTON, G. FRANK. Varicocele and its Treatment. Chicago, W. T. Keener. 126 p. 8°.
MAGNUS, SIR PHILIP. Lessons in Elementary Mechanics. New edition. London and New York, Longmans, Green & Co. 371 p. 12°. $1.20.
MARTIN, F. H. Electricity, Diseases of Women and Obstetrics. Chicago, W. T. Keener. 252 p. 8°.
MAYCOCK, W PERREN. Electric Lighting and Power Distribution. Part I. New York, Macmillan. 185 p. 12°. 75 cts.
MINCHIN, GEO. M. Hydrostatics and Elementary Hydrokinetics. New York, Macmillan. 424 p. 12°. $2.60.
MITCHELL, CLIFFORD. A Clinical Study of Diseases of the Kidneys. 2d ed. Chicago, W. T. Keener. 431 p. 8°.
POYSER, A. W. Magnetism and Electricity. London and New York, Longmans, Green & Co. 382 p. 12°. $1.50.
SAVAGE, M. J. The Evolution of Christianity. Boston, Geo. H. Ellis. 178 p. 12°. $1.
TOWNSEND, C. H. TYLER. N. A. Genera of Calyptrate Muscidæ; N. A. Tachinidæ; New Jamaica Tachinidæ; Mexican Species of Ceroplastes; Leaf-miner of Populus Fremonti. Reprints. Las Cruces, N. M., The Author.
VILLEMAIN, M. Souvenirs des Cent Jours. Ed. by G. Sharp. New York and London, Longmans, Green & Co. 188 p. 12°. 75 cts.

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Dec. 13.—Place-Names in the District of Columbia; Symposium; Discussion of Report of Special Committee; communications, W. J. McGee, On Principles of Nomenclature; O. T. Mason and Edward Goodfellow, On the General Subject.

Agassiz Club, Corvallis, Ore.

Nov. — F. L. Washburn, Oökinesis in Limax and Arbacia, prefacing the paper with illustrated remarks on karyokinetic phenomena in general. The paper set forth the results of some personal observations on living and sectioned eggs.

homa, and eastern Colorado. Coffin's short report deals with the Dakota artesian basin and contains little of value.

The papers mentioned last in our title are the irrigation bulletins of the Census Office. These have been prepared by Mr. F. H. Newell, special agent on irrigation, and they cover nearly all the territory in which irrigation has been or may be practised, except California and Nevada, and these States are under consideration. In these bulletins we have accounts of what has been done in the separate States, together with a general outline of the physical conditions. One of them is devoted to artesian wells, and in it mention is made of the various artesian areas of the States. The latest of the series is largely statistical in its character and contains four maps of the country west of the 97th meridian, upon which are shown the irrigated areas, the size of crops produced by irrigation, the proportion of irrigated land to the whole, and finally the average size of the irrigated crop holdings in various sections. This notice is already too long to enter into the details of these bulletins: we can only commend them to those making a study of this important subject.

The diverse origin and character of the publications treated of in this notice, all of them, however, emanating from the general government, cannot fail to give rise to some thought. It is observed that the Geological Survey, the Weather Bureau, the Irrigation Inquiry Branch of the Department of Agriculture, and the Census Office are all concerned in their production. It is true that the Weather Bureau is now an integral part of the Department of Agriculture, but it was not when the report in question was issued. There are, then, three separate departments of the government concerned with this work. Where it is thus divided there is certain to be more or less duplication. It will be remembered that when the surveys of our western territory under Hayden, Wheeler, and Powell were being carried on, there was a continual clash and more or less repetition. When they were finally consolidated under one head, this duplication was done away with and the work executed with equal thoroughness. If, now, the various offices investigating the irrigation question were consolidated under one management, the danger of duplication, and the expenditure of money twice over for the same work would be avoided. The intimate connection between the matter of irrigation and the agriculture of the country shows the advisability of placing it under the control of the Secretary of Agriculture. There has already emanated from that department one of the most valuable of recent reports. The connection of the Weather Bureau would facilitate the collection of rainfall and temperature statistics; and the establishment of a Bureau of Irrigation with a corps of irrigation experts, all under the control of one head, would give in the end far better results than can be expected from the diverse character the work now presents. The U. S. Geological Survey and the Census Office are collecting statistics of rainfall, estimating the flow of streams or studying the relations of soil to climate. These may properly be regarded as the work of the Weather Bureau. So, too, when the irrigation inquiry of the Department of Agriculture was in existence, it duplicated portions of the work of the Geological Survey. The time now seems ripe for a consolidation of the various irrigation inquiries. The headquarters of this Bureau of Irrigation seems by right to be the Department of Agriculture.

JOSEPH F. JAMES.

AMONG THE PUBLISHERS.

A CURIOUS undertaking, entitled "The Scientific Roll; and Magazine of Systematized Notes," has been conducted for some years by Alexander Ramsay of London. Three parts concerning meteorology are before us, with sub-title, "Climate: Baric Condition." These are occupied by a bibliography from 1688 to 1850, apparently not complete, extended abstracts from antiquated authors, and an injudicious essay by the author on "Why does the Barometer Rise and Fall?" The author's industry is praiseworthy, but the results of his industry do not seem to us of high value to modern students.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

The Biological Department of Hamline University desires to offer microscopic slides of animal tissues, or whole animals, in exchange for first-class fossils. Address correspondence to Henry L. Osborne, Hamline University, Hamline, Minn.

For sale.—A set of the Berichte der Deutschen Chemischen Gesellscaft, from Jan. 1, 1877, to Jan. 1 1892, bound in twenty-six volumes to Jan. 1, 1888 and remaining four years unbound. Also the Bulletin de la Société Chemique de Paris, from Jan. 1? 1879, to Jan. 1, 1892, bound in eighteen volumes to Jan. 1, 1888, and remaining four years unbound. Dr. Marcus Benjamin, care of D. Appleton & Co., 1 Bond St., New York City.

For sale.—1,500 bird, and 125 mammal skins, which are first-class and labelled with strictly reliable data. They were collected in this immediate vicinity and are preserved and made up according to the latest approved methods. As I offer the above at a very low price, it would be a good opportunity for a college or a museum. Willard E. Treat, East Hartford, Conn.

For Sale.—A new Model U. S. Army Hospital Microscope (Zentmayer), also 1/6-inch and 1 1/2-inch Objectives. HENRY C. WELLS, 151 Broadway, New York.

For sale or exchange.—A Stevens' new model pocket shot-gun, 44 cal., with 22-cal. rifle barrel. Just the thing for collecting birds and small mammals. Will exchange for a 22-cal. cane-gun or good books on ornithology. Write for particulars, stating what you have for exchange. R. C. McGREGOR, 2841 Champa st., Denver, Col.

For sale.—A very fine stone sword (?) so named by myself. It is perfect—15 inches in length, a little over 2 inches in width, and 1/2 inch thick. It is of a dark slate color, perhaps limestone, and is the largest implement of the kind known. Some fifteen years ago, when it was not mine, I was offered $40 for it; since that time it has come into my possession; that price will now buy it. Address Rev. C. FOSTER WILLIAMS, Ashwood, Tenn.

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SCIENCE

NEW YORK, DECEMBER 23, 1892.

THE GROWTH OF CHILDREN.

BY FRANZ BOAS.

DURING the past years a vast number of observations referring to the growth of children have been accumulated. The method of treating the results of such observations has been largely a comparison of averages and of the frequency of occurrence of cases between certain limits, for instance, frequency of occurrence of statures from inch to inch, or of weights from pound to pound.

In discussing the results of such observations, the question arises in how far the results have a physiological meaning and in how far they are purely statistical phenomena. It is generally assumed that the figures express physiological facts.

Serious objections, however, may be raised against this point of view. In almost all cases, excepting observations like those of Wretlund, Malling-Hansen, and Carlier, the observations have been taken only once on a great number of individuals, not repeatedly through a long number of years on the same individuals. For this reason the classes, when arranged according to ages, will be differently constituted. The younger classes contain many individuals who will not reach the adult stage, while the older classes contain only few individuals who will die before becoming adults. When we assume that all classes are equally constituted, we assume implicitly that the value of the measurement under consideration has no fixed relation to the mortality, which assumption seems to be very doubtful. Without considering details, it would appear very likely that individuals far remote from the average, showing either too small or too large measurements, approach the limits between physiological and pathological variation, and are therefore more likely to die. This would imply a greater variability of the measurements of deceased individuals of a certain age than of the living individuals of the same age. The series of living individuals of all ages can be equally constituted only when the measurements of the living and the deceased show the same values. This fact has already been pointed out by H. Westergaard ("Grundzüge der Theorie der Statistik," p. 188).

We have a few observations which seem to make the identity of the series of measurements of the living and of the deceased individuals of the same age very improbable. The most important among these is the peculiar decrease in the brain-weight after the twentieth year in males. This can hardly be explained in any other way than by assuming an increased death-rate among men with very large brains at an age of about twenty years.

Bowditch and Roberts have shown that, on the average, children of well-to-do parents are taller and heavier than those of poorer parents. Carlier has shown the same phenomenon by proving that a number of children of a certain class when brought under more favorable conditions (i.e., in a military training school) grow more rapidly than the rest who are left in their former conditions. We know that the mortality of children is greater among the poorer classes than among the well-to-do classes. Therefore among the young children a greater percentage belongs to the poorer classes, who are at the same time shorter of stature, than among the older children. This fact expresses itself undoubtedly in the averages of measurements collected in our public schools.

These considerations seem to me sufficiently important to doubt the physiological value of any figures obtained by means of single observations. It does not seem unlikely that the correlation between measurements and mortality is more strongly emphasized at certain periods than at others. If, for instance, many individuals of retarded growth should die during the period of adolescence, this might give the real explanation of the curious overlapping of the curves of growth of girls and boys, the girls being heavier and taller than boys between about the twelfth and fourteenth years. I am strengthened in this opinion by the observation made by Dr. G. M. West, that the extent of this period and the amount of overlapping is the smaller the more favorable the conditions under which the individuals live. It would be interesting in this connection to study the curves of a people which has a very high death rate among young children.

A second point of view which seems to limit the physiological value of the curves relating to growth is the following. I have shown on a former occasion (*Science*, Nos. 483 and 485, 1892) that, owing to the asymmetry of distribution of cases in the years preceding maturity, the average of all observed values cannot be considered the most probable value belonging to the age under consideration. I have also shown that this asymmetry and the increase of variability during the period of adolescence are purely statistical phenomena. Dr. H. P. Bowditch, in his interesting discussion of the growth of children (22d Annual Report of the State Board of Health of Massachusetts, p. 479 ff,), has compared children of the same percentile rank from year to year. He discusses the feasibility of such a proceeding and considers it likely that the same children on the average will remain in the same percentile grade. I believe it can be shown that the children are more likely to vary in rank than to remain stationary in this respect. Any correlation between measurement and mortality must have a disturbing effect. Besides this, we will consider for a moment all those children separately who will, as adults, have a certain percentile rank and investigate their position during the period of rapidly decreasing growth, during adolescence. It seems reasonable to assume that the average individual (not the average of all individuals) will retain its percentile grade throughout life. For instance, the man of the eightieth percentile grade will have belonged to the same grade when a seventeen-year-old boy. At this period a number of these individuals will be in advance of their age, while others will be retarded in growth. It seems likely that the retardation or acceleration is distributed according to the law of probability. As the amount of growth is decreasing rapidly at this period, the number of retarded individuals will have a greater influence upon the average than those of accelerated growth, that is to say, the average of all observed values will be lower than the value belonging to the average boy of seventeen years of age, and as the latter will probably have the same percentile rank throughout life, the average will represent a different percentile rank. We can show in the same way, by comparing the composition of the same percentile grade year after year, that its composition must change. During a period of retarded growth the individuals in advance of their age will be less remote from the percentile rank in question than those whose growth is retarded. Therefore the composition of each percentile grade cannot remain constant.

The interest of a knowledge of the actual anthropometric conditions of children of a certain age shall not be depreciated, but this raw material does not allow us, or at least allows us only in a very imperfect way, to draw inferences of physiological value. In order to enable us to draw these inferences, the material which we make a subject of our study must be in every way homogeneous. This can be accomplished in two ways. A very large number of children may be measured once, and year after year those who die and those whose further fates are unknown must be eliminated from the list. When all have become adults, the survivors and those who died during their first, second, third, etc., years must be treated separately. Furthermore, pains must

be taken to discover if any marked difference exists between the social composition of these groups. While this method may give satisfactory results at a moderate expense, it is far inferior in value to the method of repeated measurements at stated intervals. In this case the same subdivisions must be made, and changes in the social status and in the health of individuals must be recorded and eliminated. In order to carry out such a plan, it would be necessary to organize a bureau with sufficient clerical help to carry on the work. The questions underlying physical and mental growth are of fundamental importance for hygiene aud education, and we hope the time may not be far distant when a work of this character can be undertaken.

SOME ODDITIES IN BIRD-LIFE.

BY C. W. SWALLOW, WILLSBURGH, OREGON.

IT is not my intention, in this article, to describe any new species that are unknown to ornithologists, but there are many nature-lovers that cannot identify the birds easily; with such, I hope these descriptions may help and create a stronger desire to know more of the birds.

I will try to describe a few birds that are not as well known to the general observer as the robin, and which, by their rarity or peculiar habits, make them especially interesting to study.

The first species I will notice is Townsend's Solitaire (*Myadestes townsendii*). This is a rare bird to me, as I have never secured but one specimen. It may almost be called a hybrid between the thrushes and flycatchers, yet, by its color and flight, it somewhat resembles the shrikes. These birds are not as large as the robin, being a more slim bird with longer tail. They measure in inches somewhat as follows: Length, 8.5; extent of wings, 13.5; wing, 4.5; tail, 4.25; tarsus, .75. Their bill is about one-half inch long and strongly resembles the flycatchers, being broad and flat and slightly toothed. Bill and feet are black; the back is brownish ash, or slaty; the breast is lighter, shading into light ash on the crissum; top of head brownish black, lighter at base of bill; throat light ash; a light ring about the eye; wings and tail brownish-black; primary wing-feathers slightly edged with white and the secondary wing-feathers and outer tail-feathers quite extensively white-edged, the primaries and secondaries with a spot of yellow or tawny, giving the wing the appearance of having a bold bar of this color at the point of primary coverts; tail forked and slightly double-rounded.

This seems to be the only species of the genus found in the United States. They are probably more common between the Rocky and the Cascade ranges; but stragglers may be found west of the Cascades, even to the Pacific Coast; as I am informed by Mr. R. H. Lawrence that the species has been taken at Astoria. They are reported from New Mexico by A. W. Anthony in the *Auk*. Dr. Coues gives their range as north to British Columbia, stating that they build on or near the ground, laying bluish-white eggs, spotted with brown.

The Bushtits (*Psaltriparus*), although very small, dull-colored birds, are quite interesting and odd, as is also their nest, which is an ingeniously woven, pensile structure that may be found in bushes at the height of one's head, or twenty feet or more up in trees. One that I found last spring was near the end of a long hemlock limb, about twenty feet from the creek over which it hung. It was securely fastened to the small, slender twigs in three places. It was about nine inches long and four and one-half in diameter, outside. It was well and thickly woven, of moss and cottony substance, being strong enough to hold a number of pounds weight. The entrance was a small hole in one side near the top, and the bottom was well lined with feathers. They lay from six to nine small white eggs. These diminutive birds are only about four inches in length, with short, rounded wings less than two inches, and a narrow graduated tail somewhat longer than the wing. They are of a slate color above, shading into ashy or the under parts. They have no bright colors and are not crested. Bill and feet black. These lively little busybodies keep up a continuous twittering as they flit from twig to twig. There are but a few species found in the United States.

Psaltriparus minimus has a brown crown patch, while *P. plumbeus* has a lead-colored crown like the back.

P. lloydi has an ashy crown and black bars on sides of head. This is a southern bird, while the other two may be found as far north as Oregon or Washington.

A DEFINITION OF "SOLUTIONS."[1]

BY C. E. LINEBARGER, CHICAGO, ILL.

WITHIN recent years great progress has been made in our knowledge of solutions. This has been in main due to the application of the laws established for gases to solutions. Solutions are intermediate between liquids and gases. The theory of gases has been well developed, and the next problem is to devise a general theory of liquids. There are two ways of getting at the nature of liquids, — through the critical point and through solutions. Pellat[2] has recently shown the need of precision in the definition of the critical point, and has deduced from a consideration of the iso-thermal curves of carbon dioxide determined by Andrews[3] a definition at once concise and precise. It is my intention in this paper to subject to examination the existing definitions of solutions, and, if they be found inadequate or inaccurate, to propose another. Definitions, the preliminaries of science, are but landmarks of classification As scientific knowledge advances, the classifications and definitions change: they are provisional and progressive. Until within a few years, our notions of the nature of solutions were so vague that it was not possible to insist upon precise definitions; but now that we have a theory of solutions that rivals the theory of gases in simplicity and even surpasses it in the accuracy of its experimental results, it is time that a suitable definition be adopted.

Among the formal definitions of solutions (which are not very numerous) of acknowledged authorities, I will quote for the sake of comparison the following:—

(*a*) "Auflösung heisst, wenn sich ein fester Körper mit einer Flüssigkeit (einem tropfbar-flüssigen Körper) so verbindet, dass er in dieser Verbindung flüssig wird. . . . Die Flüssigkeit nennt man dann das *Lösungsmittel*, der vorher feste Körper heisst *aufgelöst*, und die neue Verbindung eine *Auflösung*" (Berzelius, Lehrbuch der Chemie, I., 424, fifth edition).

(*b*) "The liquefaction of a solid or gaseous body by contact with a liquid, the solid or gas being diffused uniformly through the liquid and not separating when left at rest" (Watts' Dictionary of Chemistry, article Solutions).

(*c*) "Lösungen sind homogene Gemenge, welche man durch mechanische Mittel nicht in ihre Bestandteile sondern kann" (Ostwald, Lehrbuch der allgemeinen Chemie, I., 606).

In these typical definitions there are three questions that require examination: (1) What is the state of aggregation of solutions? (2) Is homogeneity necessarily a characteristic of solutions alone? (3) What is to be understood by mechanical means, and is it true that solutions cannot be decomposed into their constituents by such means?

As to the first question, it is seen that the two first definitions regard a solution as liquid, which is, indeed, the common conception. Yet undoubtedly solids have the power of dissolving one another under certain conditions, so that a solution may be solid.[4] The expressions "solutions of gases in gases," of "liquids in gases," and even of "solids in gases" are quite general and used by good authorities. Thus the state of aggregation of solutions may be gaseous, liquid, or solid. (See, however, the definition proposed below).

But are there not homogeneous mixtures that are not solutions, no regard being had, however, to mixtures of powders, etc.? Every one knows what solutions of crystalloids, such as sugar or

[1] By solution is understood in this paper the ready-made mixture, no reference being had to its mode of formation; for the action of the solvent upon the substance to be dissolved as well as the product of the action is commonly called a "solution."

[2] De la Definition et de la Determination du Point Critique, Jour. de Phys. (3). L., 295.

[3] Phil. Trans. II. 1869.

[4] Van't Hoff. Zeitschrift für physikalische chemie, 5., [illegible].

salt, are like, and that is perhaps the reason that so little attention has been paid to the definition of solutions; what every one has a clear idea of, hardly needs defining. But when we come to speak of solutions of colloids, difficulties arise. It is not hard to distinguish true solutions of crystalloids, for they are characterized by the circumstance that for every temperature there is a fixed and constant ratio between the quantities of substance dissolved and solvent. But when we come to apply this criterion of solubility to colloid solutions, we find it insufficient. Some maintain that such solutions are in reality nothing but suspensions or emulsions[1]; and indeed this may be true in certain cases, for there exist as wide differences between colloids and colloids as between crystalloids and colloids. But the question at issue is, Can a suspension or emulsion remain perfectly homogenous for an indefinitely long time? The question can be answered in the affirmative in the case of suspensions or emulsions in which the suspended or emulsified particles have the same density as the suspending or emulsifying liquid. This is an extreme case, it is true. Still it proves that there may be entirely homogeneous mixtures which are certainly not solutions.

Again, it may be said that the surface tension between the extremely small emulsified or suspended particles and the liquid may be so great that, in comparison with it, gravity vanishes. According to this, even if there existed a difference of density between the particles and the liquid the emulsion or suspension would remain as such indefinitely. Their exist then homogeneous mixtures that may not be true solutions.

Further, under certain conditions, a true solution may become heterogeneous. If one part of a solution be at a different temperature or pressure from another, diffusion will take place and the solution will cease to be homogeneous.

With reference to the third question, probably all will agree in understanding by mechanical means, in this connection, filtration, subsidation, etc. In regard to subsidation, it has been shown above, that many emulsions and suspensions do not subside even after the lapse of a long time, so that this criterion fails in this respect. But let us see if we cannot separate a solution into its constituents by means of filtration. Take a solution of casein in dilute sodium carbonate, for instance. This passes quite freely through ordinary filter-paper; but if the paper be converted into parchment paper, although the sodium carbonate still passes quite freely through its pores, the casein is retained. If now an amorphous precipitate of ferrocyanide of copper be deposited in the parchment paper, even the salt is kept back, only the water being able to pass through the interstices of the precipitate. Thus by mechanical means a solution has been resolved into its component parts.

We conclude, then, that the existing definitions of solutions are inadequate; it remains to propose another more in accordance with fact.

Scientific definitions generally consist in the statement of certain attributes that separate as by a boundary the thing to be defined from all other things. If, then, there exists some attribute of solutions which is ever present, and indeed characterizes them as such; if other attributes are but different modes of expressing this essential attribute, such an attribute can well serve to define solutions. An attribute that fulfils the above conditions is the osmotic pressure. A solution is accordingly a *homogeneous mixture exerting an osmotic pressure.*

It is, of course, assumed that temperature and pressure are constant, else a solution might cease to be homogeneous. As osmotic pressure is a term applied only to mixtures in the liquid or solid state, it follows that "gaseous solutions" do not exist. For a "solution" of a gas in a gas, mixture is much the better term, and is indeed in common use; for a solution of a liquid in a gas, the proper word is still mixture, as well as for the rare case of the "solution" of a solid in a gas.

That osmotic pressure is the true criterion of solutions has strict scientific warrant. As soon as the conception of a pressure in solutions analogous to that in gases was gained, a great stride in advance was made. The most striking properties of solutions, diffusion, lowering of the freezing point, raising of the boiling point, are directly due to osmotic pressure; hence if osmotic pressure be predicated of solutions, it is implicitly stated that they diffuse, boil at a higher and freeze at a lower temperature than the solvent. All other properties of solutions are also more or less directly referable to osmotic pressure. The definition proposed is, therefore, entirely adequate, sharply separating solutions from all other mixtures.

[1] See my paper "On the Nature of Colloid Solutions" in American Journal of Science for March, 1892.

TEXAS GYPSUM FORMATION.

BY DUNCAN H. CUMMINS, AUSTIN, TEXAS.

PROMINENT among the strata composing the Permian formation in Texas, are the Gypsum Beds, which, taken with those of the north-west, are the most extensive of any such formations in the world. The Texas beds extend over an area of upwards of six million acres. Extending from the north line of the State, south, to the line of the Texas and Pacific Railroad, the beds vary in thickness from that of a sheet of paper up to seventy-five feet. The east line of the deposit passes Sweetwater, on the line of the Texas and Pacific Railroad, in Nolan County. The west line passes about twenty miles east of the Staked Plains. The greatest thickness of these beds is about nineteen hundred feet.

There are six forms of gypsum to be found in these beds, all contain the same chemical ingredients, but differ in their manner of crystallization: selenite, rose, massive, radiated, and fibrous gypsum, and alabaster.

The selenite is a clear, transparent variety, and may be split into very thin slices. Excellent cabinet specimens of this variety may be found in the red clays near Guthrie, in King County.

Rose gypsum is a foliated selenite, found only in one place in this belt, so far as has been reported, and that near Sweetwater, in Nolan County. The plates are fixed in the form of a rose and are so called by the people of that vicinity.

Massive gypsum is the principle form of which these beds are composed, this form occurs in beds of varying thickness at different horizons, ranging in thickness from one inch to seventy-five feet throughout this belt. It is generally white in color, but often it possesses a blue or reddish cast.

The radiated variety is usually round in figure, the lines of crystallization diverging from a common centre. This form possesses high specific gravity.

Fibrous gypsum, or satin spar as it is sometimes called, occurs in white or slightly colored deposits throughout this belt. Very few of these seams exceed two inches in thickness, although there may be seen in the museum of the Texas Geological Survey blocks of this form, from Kent County, exceeding twelve inches in thickness.

Alabaster occurs in many localities throughout the gypsum belt. Its beauty as a cabinet specimen is due to its color and translucent structure. It may be carved into many ornaments, and is capable of receiving a high polish.

Besides these six distinctive forms, the gypseous marls and the heavy beds of gypsiferous sandstones occur in great abundance throughout this area. Many of the above-mentioned forms have beautiful combinations and weatherings. Noticeable among these are a puddingstone gypsum, a combination of blue and white massive gypsum, a striated form composed of alternating layers of red and white massive gypsum, and a form of alabaster exhibiting very peculiar weatherings, grooves being washed in many directions on its surface, also a beautiful cabinet specimen from King County, it being round nodules of alabaster or selenite with a heavy incrustation of carbonate of copper.

On account of the scarcity of transportation, no uses are being made of these vast beds, which are unexcelled for use as fertilizers, or the manufacture of plaster of Paris.

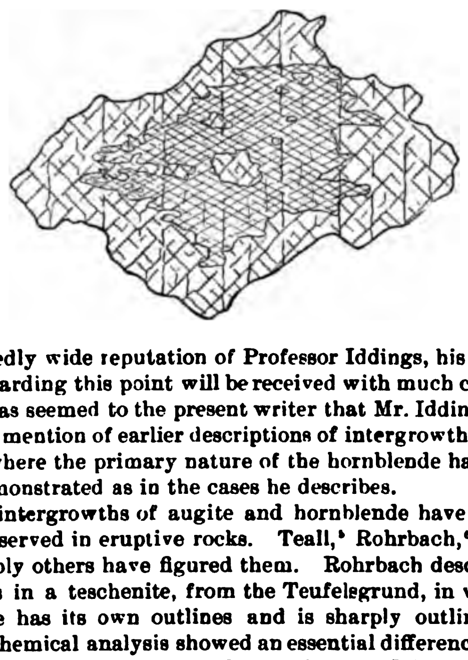
In conclusion, to the scientist, Texas presents opportunities for study excelled by no place. Her geological and mineralogical products are subjects for discussion the world over, and no prettier field is open for investigation than the Texas gypsum formation.

ON INTERGROWTHS OF HORNBLENDE WITH AUGITE IN CRYSTALLINE ROCKS.

BY WM. H. HOBBS, MADISON, WIS.

THE question of the primary or secondary origin of hornblende in a number of types of eruptive and metamorphic rocks is one of the most difficult to answer of any that are raised by their study. The number of varieties under which the calcium magnesium iron silicates that we call hornblende occurs, makes it a somewhat difficult matter to correlate results. The term "Uralite," which Gustave Rose applied to a fibrous hornblende from the Urals, which was pseudomorphic to hornblende, has sometimes been loosely applied to any variety of hornblende which may be supposed to have this origin. Other observers have distinguished "compact hornblende" from uralite, and have also carefully stated the character of the mineral's absorption. Uralite, when applied with the proper restrictions, is always an alteration product of pyroxene. It is a matter of the commonest occurrence to find basic eruptive rocks, particularly diabase, in which the alteration of augite to this mineral can be clearly seen. As regards the compact variety, it has been described as secondary to augite by Hawes,[1] Irving and Van Hise,[2] and Williams.[3]

In the beautiful monograph on the "Eruptive Rocks of Electric Peak and Sepulchre Mountain, Yellowstone National Park,"[4] Professor J. B. Iddings devotes considerable space to the description of very interesting intergrowths of augite and hornblende, both in diorites and glassy rocks. The author uses the opportunity to raise a strong doubt as to the secondary nature of compact hornblende in those cases in which it has been described. Because of



the deservedly wide reputation of Professor Iddings, his generalizations regarding this point will be received with much consideration. It has seemed to the present writer that Mr. Iddings should have made mention of earlier descriptions of intergrowths of these minerals where the primary nature of the hornblende has been as clearly demonstrated as in the cases he describes.

Parallel intergrowths of augite and hornblende have been frequently observed in eruptive rocks. Teall,[5] Rohrbach,[6] myself,[7] and probably others have figured them. Rohrbach described intergrowths in a teschenite, from the Teufelsgrund, in which the hornblende has its own outlines and is sharply outlined from augite. Chemical analysis showed an essential difference in composition between the augite and hornblende. I have described very similar growths in the augite diorite from Medford in Massachusetts. Here the hornblende is the brown variety and the augite the pink variety common in diabases. That the hornblende is primary is shown not only by its idiomorphic character, but also by the fact that the augite is sometimes almost entirely altered to clorite, the hornblende remaining fresh. Professor Iddings's conclusions will doubtless go far toward correcting any tendency to describe compact hornblende as secondary when the principal basis for it is the analogy with uralite, as his observation of an instance of hornblende altered to augite brings into the study of the relations of these minerals a new complication.

I have recently observed some rather unusual intergrowths of augite and hornblende in a rock from the "Cleveland Gold Mine" in New Marlboro, Mass. The rock is largely composed of these minerals, but is slightly calcareous and is apparently a phase of crystalline limestone. Nearly all the crystals represent intergrowths, the hornblende generally predominating and enclosing the augite, which is of irregular outline and oriented like the hornblende. Prismatic sections show a wide divergence in the extinction angles, and the hornblende is light-green and pleochroic, while the augite is almost colorless. The intergrowth figured is interesting because the augite in this instance completely surrounds the hornblende, a structure that I think is rare, as I have not seen it described. The section is nearly perpendicular to the *c* axis, since the cleavage angle in the augite was measured as 89°-90°, and that of the hornblende as 125°. While sharply contrasted by differences in their color and cleavage angle, the two minerals are more markedly distinct in polarized light. I have noticed other instances of intergrowths of these minerals within the same area, but this is the only one where hornblende was seen to be entirely enclosed by augite.

An examination of the section figured will show how intricate is the intergrowth. Islands of augite are enclosed within the hornblende. A somewhat pronounced parting parallel to the clino-pinacoid passes through both minerals. There seems to be considerable similarity between intergrowths of these minerals and the quartz which is so often enclosed within the feldspar of pegmatites. The hornblende, like the feldspar, is most frequently the enclosing mineral, and in the instance described by Rohrbach it is, like the feldspar, the more basic of the two minerals.

[1] Mineralogy and Lithology of New Hampshire, Plate vii., Fig. 1.

[2] Geology of Wisconsin, iii, 170; iv., 662. American Journal of Science (3), xxvi., 29.

[3] Ibidem, xxviii., 259-268.

[4] Extract from the Twelfth Annual Report of the Director of the U. S. Geological Survey.

[5] Quarterly Journal of the Geological Society, London, xl., 653, Plate xxix., Fig. 3

[6] Ueber die Eruptivgesteine in Gebiete der schlesischen-mährischen Kreideformation. Min. u. petrog. Mitth., vii., 24, Plate I., Figs. 1-7.

[7] On the Petrographical Characters of a Dike of Diabase in the Boston Basin. Bull. Comp. Zoöl., Harv. Coll., xvi., 10, Plate i., Fig. 2.

OPTICAL ANGLE AND ANGULAR APERTURE.

BY ALFRED C. LANE, MICHIGAN MINING SCHOOL, HOUGHTON, MICH.

THE observation of the brilliantly-colored images which are given by various crystals, natural and artificial, in polarized light is of considerable diagnostic value. The apparent breadth between the two branches of the hyperbola which may be seen in the image given by many biaxial substances, e.g., white mica, is dependent upon the optical angle,—a constant characteristic of them. The relation between this breadth and the "optical angle in air" (2E) is usually found by noting the apparent breadth in the case of a plate whose optical angle is somehow otherwise known (see Iddings's translation of Rosenbusch's "Microscopic Physiography," also Czapski in the Neues Jahrbuch für Mineralogie, etc., 1892, supplementary vol. vii.).

I wish to describe briefly the very simple method that I use for determining said relation, which also may be used *to determine the angular aperture of the objective.*

It works well in class, and the only reason why it has not long ago been adopted seems to be that the German microscopes on which the technique of the subject has been developed are not built to admit of it. But any microscope whose mirror-bar is graduated to measure the obliquity of the light will do.

We will suppose, then, that we have such a microscope, that above and below our plate of mica we have nicols, below it a strong condensor, and above a short-focus objective.

We may use a camera and project the image with its hyperbola on paper, but we will suppose that instead of that we use a Bertrand lens. which slips into the tube between eye-piece and objective, and with the former makes a compound microscope which magnifies the image given by the objective alone. We will also use a micrometer eye-piece. To measure the distance between the hyperbola branches, the micrometer scale must run diagonally. After noting the position of the branches on the scale, turn it till it runs right and left, the same way that the mirror swings. Then, without altering the distances between Bertrand lens, objective, and eye piece, lower the whole tube until the front of the

objective is down to the axis about which the mirror rotates. Use the plane side of your mirror, and reflect the image of a distant object, e g., a dot on a window-pane, *which must also be in the line of the axis of the mirror's rotation*, into the field of view so that the aforesaid dot will appear in the centre if the mirror is directly beneath.

If all is properly adjusted, on moving the mirror-bar to and fro, the dot will always appear reflected from the centre of the mirror. The angle through which the mirror-bar must be swung, so that the image of the dot may be first where the apex of one branch of the hyperbola was and then where the other apex was, will be the optical angle in air (2E). The angle, which may be swung from where the dot disappears on one side to where it disappears on the other, will give the angular aperture of the objective used.

SUBDIVISIONS OF THE AZOIC ARCHÆAN IN NORTHERN MICHIGAN.

BY M. E. WADSWORTH, STATE GEOLOGIST, HOUGHTON, MICH.

THE work of the Michigan Geological Survey in 1890 made it clear that the Azoic system of the Lake Superior district of northern Michigan was composed of at least three unconformable formations. This conclusion was published by me early in 1891, in an article entitled "A Sketch of the Geology of the Marquette and Keweenawan Districts," which was appended to a pamphlet called "Lake Superior — Along the South Shore," New York, 1891. These general conclusions have been confirmed by the work of the two subsequent seasons, and two other unconformable formations rendered probable, although not yet proved conclusively. A discussion of these points will subsequently be given in detail in the reports of the State geologist.

The following are the formations as made out and named from prominent localities by the Michigan Survey, commencing with the oldest. There are given with this the formations as determined by the United States Geological Survey, showing their supposed equivalency.

	Michigan Geological Survey.		U. S. Geological Survey.
Azoic, or Archæan, System.	Laurentian (?) Period.	Cascade Formation.	Fundamental Complex.
	Huronian (?) Period.	Republic Formation. Mesnard Formation.	Lower Marquette Series.
	Michigan Period.	Holyoke Formation. Negaunee Formation.	Upper Marquette Series.

POTATO SCAB.

BY H. L. BOLLEY, FARGO, NO. DAKOTA.

THIS disease of the potato-tuber need not longer mar the appearance. quality, and economic value of the crop. The corrosive sublimate treatment, recommended in Bulletin No. 4, of North Dakota Experiment Station, has had another year's trial, not only at this station but by potato-growers, and it has again proven effective in a degree beyond previous expectation. Though the damage done each year by this disease is so great and widespread in its occurrence, no plant-disease now successfully combated is so easily prevented and at such a slight cost.

As indicated in my work of previous seasons, it is again demonstrated this past season that the damage to the yield of the crop is very much in excess of that usually supposed. The disease attacks not only the tubers but the base of the vines also; the result is a shorter-lived vine, a greater number of potatoes set upon the vines than there would be under normal conditions, and, third, much smaller tubers. The second of these statements, perhaps, needs some explanation. I have only one to offer, which I think to be about the correct one, i. e., the disease early attacks the young tubers as they set upon the vines, normal growth is checked, and the excess of vigor in the vines which is at its highest stage at this time finds expression in the formation of new tubers to the further detriment of those already set upon the stems.

The results of this summer's work when averaged for all tests show an average gain of one-half pound per hill in favor of the treated seed-tubers, and 99.33 per cent of total product void of disease; while untreated seed in all cases gave a product in which less than one per cent undiseased tubers were found.

The cost of treatment for a crop of two or three acres of potatoes need not exceed fifty cents, aside from that of one or two days' extra labor.

Details of the season's work will soon appear in bulletin form.

THE fourteenth edition of Franklin Leonard Pope's "Modern Practice of the Electric Telegraph" has just appeared (D. Van Nostrand Company, 234 p., 8°, $1.50). This is a technical handbook for electricians, managers, and operators, and contains 185 illustrations. As this book has been a standard authority on telegraphy for almost a quarter of a century, it is unnecessary to say anything to those already familiar with it, except that it has been rewritten, enlarged, and brought to date. To others, it is sufficient to repeat that this is the fourteenth edition of a comprehensive and handsomely illustrated work.

— The Johns Hopkins University has published a large geological map of the vicinity of Baltimore, prepared by Professor G. H. Williams. It is an extension of a similar map prepared by Williams and Darton and published by the U. S. Geological Survey some months ago; but the coloring on the present issue departs from the color system adopted for the Survey maps; as if experimentally to try another device, better applicable to the region here included. The experiment is successful; but it does not follow from this isolated instance that the color scheme of the Survey should be changed in its uniform application to the great series of maps for which it was prepared.

— The Geological Survey of Missouri, Arthur Winslow, director, has issued an atlas report on the Higginsville map-sheet, with two colored maps and several papes of text, chiefly concerning the coal measures of the region. The large form of the report avoids the difficulty of folding the maps, which constitute its chief feature; but the size of the atlas is inconveniently large for easy keeping in the library or on the desk. As a forerunner, however, of what we shall have to deal with when the publication of similar atlases of maps and texts is begun by the U. S. Geological Survey, the Higginsville atlas gives us useful practice. The extension of such a series of reports to include the other map-sheets of Missouri will add greatly to our information about that State.

— Professor F. A. Forel of Morges, Switzerland, has long been known as a careful investigator of the natural history of Lake Geneva, on whose borders he was born and bred. Several years ago he published a small pocket volume on the various features of the lake; and now we receive from Rouge of Lausanne the first of three volumes, entitled "Le Léman; Monographie Limnologique." Judging the whole work by what now appears, as well as by the high standard of Forel's previous writings, it is not too much to say that it will take an eminent place among scientific monographs, ranking with Favre's "Alps of Savoy" and Heim's "Mechanism of Mountain-Making." The division of the present volume which will excite most general interest is the serious discussion of the origin of the lake, from which Forel concludes that, of all suggestions, the one which ascribes the basin to the warping of a pre-existent valley is by far the most probable. The winds of the lake are fully described; but in the excursions in connection with them into the theory of cyclones and anticyclones, the author evidently ventures into a field somewhat unfamiliar to him; his suggestions on this subject not being made in view of all that is known about it. The second volume will include an account of the *seiches*, or oscillations, of which Forel has already written so much; the third will discuss the biology of the lake and its human antiquities. An excellent map accompanies the first volume.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

ON NATURAL AND ARTIFICIAL IMMUNITY.

BY O. LOEW, MEMBER OF THE UNIVERSITY OF MUNICH, FORMERLY MEMBER OF THE WHEELER EXPEDITIONS, WEST OF THE 100th MERIDIAN, OF THE U. S. CORPS OF ENGINEERS.

SINCE the beginning of the extensive bacteriological investigations of Pasteur, about twenty years ago, the new-born science of bacteriology has developed to gigantic proportions, and, although this science is still in its youth and capable of an immense extension, it has become of an extraordinary importance and of universal interest. No other science can boast of such rapid development. Many investigators, botanists, hygienists, physicians, and chemists, have contributed their share to raise the science to an imposing figure. We name here above all: C. Nägeli, R. Koch, Rudolf Emmerich, Hans Buchner, M. Nencki, the Italians Tittoni and Cattani, the Americans Billings and Dixon, the Japanese Kitasato and Tsuboi, the Englishman Hankin, and the Germans Hüppe, Scholl, and Baumgarten.

It was Koch who invented excellent methods of isolating different bacteria species and made us acquainted with the bacillus of tuberculosis and the comma-bacillus; Kitasato isolated for the first time the bacillus of influenza and of tetanus (lockjaw); Nencki, Krieger, Hüppe, and Scholl isolated poisonous albuminous products of different bacteria species. But it was essentially Professor Rudolf Emmerich of Munich,[1] whose everlasting merit it is to have taken the first successful steps for solving the mystery of natural and artificial immunity.

We know now that nine-tenths of all diseases of man and animals are due to certain bacteria species that either by the lungs or by the stomach enter the body, multiply in the blood, and yield poisonous secretions that finally attack the nervous system and kill the body if no powerful reaction sets in that kills the bacteria, while their poisonous secretions are expelled by the body by oxidation or by the excreta.

Now, this reaction against bacterial evil-doings is the most interesting and marvellous process in the science of bacteriology and medicine, a process that was surrounded by a deep mystery, and the more interesting as it became evident that an animal having passed through a certain infectious disease, had acquired a certain resistance for a certain period against the same cause of disease. Experiments of Pasteur had shown this to be the case in various diseases. This resistance gained by passing through an infectious disease is known by the name of artificial immunity.

There exists, however, also a natural immunity, that is, the resistance of certain animal species against certain kinds of bacteria, without ever having passed through an infectious disease. For instance, rats and dogs are incapable of getting tuberculosis or swine plague (roth lauf), rats are incapable of anthrax, most animals are incapable of typhoid fever and Asiatic cholera.

It was Professor Emmerich who discovered first, in 1886, that the blood of an animal that had recovered from an infectious disease can cure another animal from the same disease or even prevent the development of the same disease if subcutaneous injections are made. He had proved, for the first time, that the bacteria in question are killed rapidly in the blood of an animal that had acquired immunity. He supposed, at that time, that there are formed certain albuminous combinations that act as poisons upon the barteria. Sometime afterwards, H. Buchner proved indeed that the fresh blood of various animals contains albuminous bodies detrimental to bacteria and that the natural immunity is thus easily explained, while for the artificial immunity this was proved later by Emmerich. This was to many a remarkable surprise, for all albuminous substances had been heretofore considered as the best nutrition for every living cell.

But this surprise was not altogether justified, for two Americans, S. Weir Mitchell and Edward Reichert, had demonstrated that the poison of the rattlesnake consists of two albuminous bodies, and a little later such poisonous combinations have been isolated from the seeds of *Abrus preratorius* and of *Ricinus communis*. Now, if there existed albuminous bodies noxious for the higher animals and not for bacteria, there could not more be wondered at, if albuminous bodies existed noxious to bacteria and not for animals. There exists, however, a third class of albuminous substances (proteids) noxious to both animals and bacteria.

Here must be mentioned, also, the theory of Metschnikoff in regard to the disappearance of bacteria in the blood of an infected animal. He had observed that the white blood-corpuscles or lymphatic cells devour living bacilli, for instance, the bacteria of anthrax, and he believed therefore, this to be the principal way to get rid of the entered bacteria. This theory of the phazorytose, however, did not give sufficient explanation in several regards.

The investigations of Professor Rudolf Emmerich have shown us that the albuminous bodies of the serum of dogs' blood, when precipitated by alcohol and redissolved in water containing 0.4 p. mille caustic soda had microbiocide properties even then, if by the treatment with alcohol this property had been lost in consequence of a slight chemical change. This proved that a certain atomic constitution can be restituted by the very diluted solution of caustic soda. Not so easily changeable by alcohol is, however, the albuminous body causing the artificial immunity, as Emmerich has found, and while it is easy to cure with blood of artificially immunized animals, no one was able until now to observe a cure by application of blood of naturally immune animals. One cannot immunize, for instance, with dog's blood against tuberculosis of man or with the blood of rabbits against typhoid fever.

Professor Emmerich and Professor Tsuboi have investigated the blood of rabbits that were artificially immunized against swine-plague (roth lauf). The serum of this blood was (after separation of the globulin) concentrated at 42° C. in vacuo, whereby an albuminous body of prominent curing properties was precipitated. The filtered liquid, however, gave upon precipitation with alcohol also a substance of the same curing qualities. This substance was washed with alcohol and ether and dried at a low temperature. This dry powder possessed all the curing properties of the blood itself against swine-plague. Thus we have for the first time the curing substance (Heilsubstanz) in a dry state, although mixed yet with inactive albuminous substance. This is a fact of immense importance, the most important discovery in bacteriology relating to medicine. Emmerich and Tsuboi gave also a plausible theory in regard to the formation and the mode of action of this remarkable substance, as may be studied in their publication, "Die Natur der Schutz und Heilsubstanz des Blutes," Wiesbaden, 1892. We hope to communicate later more of the investigations of Emmerich and Tsuboi.

A few additional remarks may be permitted to the writer. The great admirable transatlantic republic, with its unrivalled wonderful development, with its immense natural resources, and an unheard of liberality and magnanimity and generosity of

[1] Professor Emmerich is the most successful student of the far-famed hygienist, Professor Dr. Max v. Pettenkofer of Munich.

prominent citizens, as Senator Sanford, Johns Hopkins, Clarke, Lick, Cooper, etc., ought also to take the development of bacteriological research in consideration. Should there not exist a second Lick, who will help revealing with microscopes mysteries of just as high interest and still more practical bearings, like the first Lick with his telescope helped to reveal mysteries of the heavens? Thus far Europe is ahead in such studies, but I know that the ambitious Americans want to excel all other nations in every respect. The United States is bound to become in every scientific branch the first country on earth. This is my firm conviction.

SOME RELICS OF PRIMITIVE FASHIONS IN INDIA.

BY MR. KEDARNATH BASU, COR. MEMB. ANTHROP. SOCIETY, BOMBAY.

"THE ideal," says Theophile Gautier, "torments even the rudest natures. The savage who tattoos his body, or plasters it with red or blue paint, who passes a fish-bone through his nostrils, is acting in obedience to a confused sense of beauty. He seeks something beyond what actually is; guided by an obscure notion of art, he endeavors to perfect his type." Coquetry and neoterism are the peculiar characteristics of man. From the dawn of the Stone Age onwards man is known to have adorned himself with feathers, coral, shells, bone, wood, and stone ornaments; but the exact time when he commenced painting and tattooing his body and face is beyond the ken of history.

Tattooing the body and the face is one of the favorite, though painful, methods of adorning the body among savages, more especially among the Polynesian Islanders. This savage ornamentation of the body has permeated many of the so-called civilized and semi-civilized people, such as the modern Hindoos, the Burmese, etc. There is no mention of this savage and rude art, to my knowledge, in any of the ancient Sanscrit works, where other methods of decorating and ornamenting the body in all times and on all occasions are put down in detail. This art, if it may be so called, was not known to the aborigines of India till a recent date, and it may, therefore, be surmised that the Hindoos borrowed the rude and savage art from some race or races outside of India. I strongly incline to believe that this practice came to India from the Malayan Archipelago through Burmah to eastern Bengal, and through southern India upwards to the whole northern part of India.

The rude and savage custom of tattooing is still in vogue among almost all classes of Hindoo females and in almost all parts of India. The face, chest, and the arms are generally tattooed with varied and fantastic designs. The remnant of the savage custom of painting the person is to be seen in the red paint over the forehead, extending to the crown, among the married women of India. Both of these customs are rapidly waning with the refinement of the people. I do not see the same profusion, as I saw ten or twelve years ago, of tattoo-marks and red-ochre or red oxide of lead (*sindur*) over the forehead and crown among the women of Bengal. The rapid stride of female education and the consequent refinement in æsthetic taste are the causes of the decline of this rude and savage adornment; but the people of Behar, the North-Western Provinces, etc., still cling to these remnants of savagery. The up country women, besides tattooing their bodies and painting the head with red paint, bore the lower lobes of their ears, and insert big and heavy wooden cylindrical plugs, which almost sever the lobes from the ears. The plugs are sometimes as big as two inches in length with a diameter of an inch and a half, and as much as two ounces in weight. These heavy plugs pull down the lobes of the ears as far as the shoulders, and give the wearers a hideous look. The Marwaree women, besides tattooing their bodies and faces, ornament their upper incisors by drilling holes and plugging them with gold, and sometimes with carvings or engravings. The latter ornamentation is usually in the form of two or more concentric rings. The women in the North-West Provinces, Behar, Bengal, and elsewhere sometimes, color their teeth black with a kind of astringent tooth-powder, called *misi* or *manjan*. Painting the feet with scarlet paint (*alakta*) is prevalent among the Hindoo women from a remote age. The Mahomedan women, and the Hindoo women after them, paint the tips of their fingers and the palms with *henna* (*Lawsonia alba*) leaves. The Jains, on certain social ceremonies, paint their hands and feet with *henna* leaves. The up-country and Marwaree women wear their *sarees* and petticoats below the navel, and artificially cause the muscles of the belly to hang down loosely in a fold over their wearing apparel, thus causing an ugly appearance to the contour of the trunk. Some of the men also adopt this fashion, and destroy the natural beauty of the abdomen.

The Burmese men tattoo their entire bodies from the legs up to the chest and shoulders with blue and red pigments, with designs of animals and dragons. The lower limbs from the waist down to the ankles are tattooed in blue, while the parts above the waist are ornamented in red. These people tattoo their bodies as a mark of manhood, and ascribe special *charms* to every particular design. A Burmese priest or *phoongie* told me that men only are decked with tattoo-marks, the women do not mar their natural beauty with permanent pigments. The Burmese women look down with contempt upon men who fail to tattoo their persons, and would not marry a man who has not been tattooed. But the *Mugs*, both men and women, tattoo their bodies.

The wings of butterflies and wing-cases of beetles were, and are to some extent, in use as ornaments among the women of India. The wings of butterflies have now given place to artificial ones, made of mica sheets and paints, which, however, bear the name of butterflies or *ticklies*. The wing-cases of gaudy beetles are still in use in Bengal and elsewhere. The wing-cases of the Indian blister-fly (locally known as *Kánch pókâ*, or glass insect), are generally used by women of Bengal. These wing-cases and *ticklies* are worn stuck upon the forehead, in the space between the eyebrows, or a little above it.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Notes on a Captive Pocket-Mouse.

IN November, 1889, I found a pocket-mouse (*Perognathus fallax*) in one of my traps, alive and unhurt, though torpid with cold, and took a fancy to keep it a captive to study its habits. It warmed slowly, and was some hours in regaining its usual state of activity. I have found individuals of other species and genera of this family (*Saccomyidæ*) chilled in traps, and it seems probable that, while they can bear considerable cold if free to move about rapidly, if compelled to keep quiet, they speedily succumb to cold. On this November morning the cold was sufficient to produce but a slight rime on the grass. This pocket-mouse was not wild, but allowed handling freely from the first. It would walk up my sleeve, around my neck, and down the other arm, and for a year or more would not try to jump to the floor, but later it seemed to have lost the sense of depth, and now it will jump down after a little walking about, even if the fall is far enough to injure it. It has never tried to bite me, and will quietly bear stroking and carrying about in my hand, though it seems to be getting somewhat wilder. I put it in a wooden box of perhaps a cubic foot in capacity, and put in an inch or so in depth of dry sand. For the first two years its habit was to dig and scratch in this sand each night, often making noise enough that I could hear it through my closed bed-room door, just outside of which the box was placed, but I never heard it scratching in daylight, and for some months I have not heard it in the night. It has not gnawed the wood as true mice would have done, and has not lifted the lid, which was kept closed by but its weight. If taken out of the box after dark and turned loose on the floor of the sitting-room, it moves about actively a few minutes, usually by short, deliberate, rabbit-like jumps, but if frightened it leaps two feet or more, as if shot off by a spring. After it has satisfied its curiosity, it creeps into some dark place behind a piece of furniture. In daytime it hunts a dark place immediately, if al-

lowed to, and is easily caught, while after dark I must corner it to catch it. I have heard it make no vocal sound save a slight squeak if accidentally hurt. It appeared to be fully adult when caught, but I have no other means of knowing how old it then was. It now acts as if feeling the effects of age. At first I tried feeding it grain, seeds, and green food. It would eat no green food that I gave it and would not touch water. For two years I have given it only dry barley or dry wheat and no water. It seems to prefer the wheat. It is a mystery to me how such an animal can live and thrive for years on dry grain without water or moisture in any form. Once or twice a year I empty its box and put in fresh, dry sand, and set the box in an angle in the hall where it is perfectly dry. I put nothing more in the box but dry grain and a little cotton to make a nest of, yet under these conditions it has lived three years. Many birds and animals do not drink water, or but rarely, but most such eat either green food, soft insects, or freshly-killed flesh, from all of which sources some moisture is obtained.

From where does my pocket-mouse get its moisture? Some seems necessary to make blood, replace water evaporated from the lungs and skin and other waste. F. STEPHENS.

Santa Ysabel, Cal., Nov. 22.

Confusion in Weights and Measures.

THE interesting article in *Science* Nov. 25, on "weights and measures in England versus the decimal and metric system," recalls to my mind the difficulties I once experienced in stating the value in grains of a U. S. gallon of water at 60° F. A telegram was handed me one morning, requesting the above information, and I requested the messenger to wait until I had written a reply. Much to my astonishment, there existed the greatest confusion among the authorities upon this simple point, and it took me several months of investigation before I could write a satisfactory answer to the above telegram. Among the values noted were the following:—

U. S. Pharmacopœia, 1870,	58328.8862 grains.
" " 1880,	58349.6 "
Miller's Chemistry,	58317 3 "
Am. Chemist, Vol. I., p. 318,	58319.8 "
U. S. Dispensatory (last edition),	53328.886 "
Oldberg's Weights and Measures,	58335.218 "
U. S. Treasury Department,	8.3312 pounds.

The report on "Weights and Measures," by the Secretary of the Treasury (Senate Doc., 1857), says: "The gallon is a vessel containing 58372.2 grains (8.3389 pounds avoirdupois) of the standard pound of distilled water, at the temperature of maximum density of water, the vessel being weighed in air in which the barometer is 30 inches, at 62° F."

In view of all this confusion I thought it best to calculate a value for myself, basing my work upon the weight of a cubic inch of water as given in Barnard's "Metric System." My result was: "The U. S. gallon of distilled water at 60° F., weighed in air at 60° F., with barometer at 30 inches, weighs

58334.94640743 grains.

Referring to this result, Dr. Rice, Chairman of the Committee of Revision of the U. S. Pharmacopœia, was good enough to say: "Until further information is supplied, the value reported deserves preference before all others. It seems, however, highly desirable that this whole question of standards and relation of weight to measure, be finally settled by law, and preliminary to this, by a new scientific investigation which might be most suitably conducted under the auspices of the National Academy of Sciences or some other representative scientific body."

This U. S. gallon, of which we have been speaking, is, as is generally known, a survival of the old English wine gallon of 231 cubic inches, which has become disused in England since the Imperial gallon was introduced in 1826. It is not generally known, however, that although dignified by an apparently "standard" title, the U. S. gallon has no statutory existence whatever. In this lack of formal recognition the gallon does not stand alone, for not one of our common weights and measures, with the single exception of the "Troy" pound has any place upon the national statute books. In 1878 an act was passed providing that "For the purpose of securing a due conformity in weight of the coins of the United States, the brass troy-pound weight procured by the Minister of the United States at London in the year 1827, for the use of the mint and now in the custody of the mint at Philadelphia, shall be the standard troy pound of the mint of the United States, conformably to which the coinage thereof shall be regulated." Thus even the troy pound is seen to have no official recognition for general use, but only for the special purposes of the mint.

It is curious in this connection to note that the metric system, as a whole, was legalized in this country by act of Congress of July 28, 1866. The act reads: "It shall be lawful throughout the United States of America to employ the weights and measures of the metric system; and no contract, or dealing, or pleading in any court shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights or measures of the metric system." By act of Congress the Secretary of the Treasury was directed to furnish each State with "one set of the standard weights and measures of the metric system." It is true that an act passed June 14, 1836, directed a distribution to be made to the several States of complete sets of "all the weights and measures adopted as standards," reference being made to the weights and measures then and now in common use, but it will be found upon inquiry that the expression "adopted as standards" refers to an action of the Treasury department made on the recommendation of Mr. Hassler in 1832, and not to any action on the part of Congress.

To quote from the report of the Secretary of the Treasury for 1857:—

"The actual standard of length of the United States is a brass scale of eighty-two inches in length, prepared by Troughton of London, and deposited in the Office of Weights and Measures. The temperature at which this scale is standard is 62° F., and the yard-measure is between the 27th and 63d inches of the scale."

"The gallon is a vesssel containing 58372.2 grains of the standard pound of distilled water, at the temperature of maximum density of water, the vessel being weighed in air in which the barometer is 30 inches at 62° F."

"The standard of weight is the troy pound, copied by Captain Kater in 1827 from the imperial troy pound. The avoirdupois pound is derived from this; its weight being greater than that of the troy pound, in the proportion of 7,000 to 5,760."

This troy pound was, as has been said, afterwards recognized by act of Congress, thus becoming distinguished from the other so-called "standards." WILLIAM P. MASON.

Rensselaer Polytechnic Institute, Troy, N.Y., Dec. 13.

Is There a Sense of Direction?

ON the first of May last, my camping outfit started from Austin, Texas, bound for the northwestern part of the State. They went through the country, taking with them our camp dog, "Old Rock," a common cur.

Professor Cope of Philadelphia and myself joined the party at Big Springs, two hundred and fifty miles from Austin. Our destination was the upper Red River and the Staked Plains. We travelled northward along the foot of the plains, sometimes without a road, for about one hundred and fifty miles. Thence we went west one hundred miles, and thence south across the high plateau of the Staked Plains one hundred miles. Thence we turned east, crossing our former route at Clarendon, continuing southeastward to Archer County, a distance of one hundred miles. We then went southwestward seventy-five miles, and then back eastward to Archer and Montague Counties. From there we turned southward to near Dallas, where I disbanded my party, and started my outfit back to Austin, the last of October. We had been in the field six months. "Old Rock" had faithfully followed the wagon except at one time, when, his feet getting sore from travelling in the hot sand, he had been hauled for a few days.

After the outfit started for Austin and when at Hillsboro, one

hundred and thirty miles from Austin, they lost the dog. We had travelled, in a general way, around two sides of a triangle, and were now making the third when the dog got lost. A few days ago, one month from the time he got lost, the dog came back home, fat and foot-sore.

Now it was utterly impossible for him to have taken the back track and to have returned home by the way we went out. How did he find the way from Hillsboro to Austin, if he had no sense of direction? for he had never been over a step of the way between the two places.

W. F. CUMMINS,

Texas Geological Survey, Austin, Texas, Dec. 2.

The Need for Popular Scientific Instruction on Oriental Subjects.

THE prevailing fad for the uncanny and the remote, having passed beyond the stages of spiritism and "Korashan science" into those of Neo-Buddhism and "theosophy," is rapidly taking shape as an eager curiosity for information regarding the religious and philosophical ideas, the literature and the customs of the far-east, coupled with a tendency to look there for a fuller light and a more perfect practical direction to life than the religion and science of Christendom can afford. They who look upon the cultivators of this taste as grossly astray from the path of reason and common sense must assign the source of the delusion to an ignorance of the real character of that Oriental civilization to whose meretricious fascinations they have succumbed.

Those, on the other hand, who are more or less in sympathy with the orientalizing movement will, if perfectly sincere, retort that the contempt for Oriental ideas, or indifference to them, which exists in various degrees among the greater public, results from the prevalence of gross misconceptions regarding them, and a lack of familiarity with the literatures which express them and the social conditions in which they are practically realized.

The two parties are agreed, therefore, that more light needs to be thrown upon the subject; that there is, in fact, a crying need among the people at large for accurate information on Oriental subjects.

The same antithetical concord, if I may be permitted the expression, exists between the defenders and opponents of the historical accuracy of the Hebrew Scriptures. Both urge the necessity of a wider diffusion of the results of recent Egyptological and Assyriological researches.

The world is becoming so small since the apparition of steam and electricity, in their protean applications, that the thought and life of one portion of it can no longer be a matter of indifference to another, even the most remote; and a man can no longer be considered cultured whose thought and sympathy are limited by the boundaries of a nation, the shores of a continent, or the formulæ of a cult. No religion, and no social conditions, can be considered otherwise than as anachronisms, which are unable or unwilling to bear an impartial comparison with all others of every country and every age.

And if a truly scientific conception of the history and needs and destiny of humanity be the great desideratum, it is clear at the first glance that it can never be attained until we cease to identify humanity with the little ethnic, or geographic or religious group to which we may chance to belong; and we can never cease to do this until we have become far more familiar than we at present are with those oldest and most powerful of civilizations which have their seat upon the Asiatic continent.

For the student of anthropology there are other and special inducements for the fullest possible exploitation of the Oriental lands and peoples. They alone have a known history of a sufficient extent to be of any marked value in unravelling the numerous problems connected with the history of progress and the phenomena of retrogression. It is the East which has afforded, or must afford, the key to the chief enigmas of ethnology, of philology, of archæology, and, above all, of *hierology*, or comparative religion. In India we can follow the trend of philosophical speculation, and the changes of religious thought and sentiment, either internally elaborated or exteriorly impressed, for a period of not less than 3,200 years; the less intense and all-absorbing religion of the Turanians can be traced backward through more than six thousand years to the lowlands of Mesopotamia or the plateaus of the Altaï; and in relatively modern times we are permitted to witness in the history of Buddhism the successive metamorphoses of a great cult in the course of its transmigrations from country to country, from continent to island, from lowland to upland, from the monkhood to the people, from the Aryan to the Turanian stock, from an agnostic or atheistic to a pantheistic, a dualistic, a monotheistic or a polytheistic form.

The wonderful richness of this field for the student of the history of religions would suggest that if a medium of popular instruction in Oriental lore could be established, it might well afford expression at the same time to that fascinating and all-important science.

A recognition of the needs, some of which I have here roughly outlined, has induced me to undertake the publication of a bi-monthly magazine, whose object will be an impartial presentation, from every point of view, of all branches of Oriental science and every aspect of the comparative history of religions. I shall be glad to have the coöperation of all who are at all interested in these subjects.

MERWIN-MARIE SNELL.

Washington, D.C., Office of the Oriental Review, 2,128 H Street, N.W.

Algebraic Notation.

IN a communication to *Nature*, issue of Nov. 3, W. Cassie points out the advantages of a proposed new notation for indicating algebraical operations. In addition to the oblique line for division (now in use in some English scientific works), another oblique line, from left to right downwards, is employed to denote an exponential operator. Thus the quantity which follows this sign is the exponent of that which precedes. In complex expressions the lines also perform a bracketing function. Besides these two marks the radical sign is used to denote evolution, and it is this which the writer deems inexpedient.

In algebra the employment of both radical signs and fractional exponents adds unnecessary confusion to a subject rather difficult in itself. There is no good reason — except that both are in use — why both should be retained. The fractional exponent notation, of course, must be kept, since it serves for all cases; and there is certainly very little justification for setting apart a special symbol for indices whose numerators are unity. I tested all the radical expressions given in the letter referred to and found no difficulty in writing them in the fractional exponent notation. Indeed, the figure 1 in the numerator might be omitted, being understood. The symbol resulting suggests the radical sign itself, only that the quantity precedes and the exponent follows the sign. A notation which avoids all special spacing and various sizes of type, writing all expressions in ordinary letterpress has certainly a worthy aim, and it would be a pity to burden it with an unnecessary symbol out of symmetry if not out of harmony with another.

JOSEPH V. COLLINS.

Miami University, Oxford, O., Nov. 30.

Electric Phenomena on Mountains.

Two notes of great interest regarding this subject have appeared in this journal for Sept. 23 and Dec. 2. The phenomena of electric discharges from elevated points on the earth's surface were first noted, so far as I know, by a savant on the great pyramid in Egypt. As he stood on the pyramid with a bottle held at arm's length above his head, he heard the peculiar spitting and sputtering produced by the electricity passing from the bottle. The description by Mr. Stone is especially valuable, and shows the extreme importance of making careful observations. Close attention is being paid by the Weather Bureau to all manifestations of this kind on Pike's Peak. It is my impression that the origin of the phenomenon is not an electric cloud passing overhead but a discharge from, or to, the earth under an electric strain or change of potential. A mountain summit forms a point for discharge of electricity like a point on the conductor of an electric machine. On Mt. Washington this discharge frequently

continues all night. One frequently finds it impossible to sleep there though in the very best of health, and this is directly attributed to the electric discharge, this fact is noted by Mr. Stone.

To my mind the most important line of investigation is that regarding the connection between this discharge and the agglomeration of vapor molecules into cloud particles. Experiments have already shown a most marked effect upon steam when an electric discharge is passed into it. On Mt. Washington there are dense clouds weeks at a time, while a mile or two from the summit the sky may be perfectly clear. A most careful study of the phenomenon has shown that it could not be due to the rocks of the summit being cooler than the air, as thought by many, for the rocks were always warmer than the air except on nights when there were no clouds. Nor could the persistent cloud be due to the expansion and consequent cooling of air rushing up the side of the mountain for the peak is a sharp cone at the last 500 feet and the cloud-hood extended on all sides to a mile or two. It would seem probable that a careful study with instruments of the phenomena of mountain electric discharges would shed a great deal of light on the exceedingly complex subject of clouds and rain-formation about which we know nothing except that the ordinary theories need thorough revision. H. A. HAZEN.

Washington, D.C., Dec. 10.

A Multiple Key.—Preliminary Note.

IN psychological laboratories it is frequently desirable to make or break two or more electrical currents at the same instant.

Ewald's key solves this problem for the most simple cases, but a need for something more elaborate was felt. This led to the invention by Dr. Scripture and the construction in the work-shop of the Yale Psychological Laboratory of a multiple key which meets all present requirements. Ewald's key costs 20 marks; this one, made by the laboratory mechanic, of unlacquered brass, without platinum contacts, was made at a cost of less than $10.

It is arranged so that five currents can run through it. One, two, or three of these can be made and one broken at the same time. The other can either be made or broken at the same time or broken for an instant and then made again; or these makes and breaks can be adjusted so as to occur one after the other in any order. By reversing the key, it gives three breaks and two makes.

An illustration of the use of the key can be taken from one of the problems in reaction time now being investigated. A single movement of the key first breaks the shunt of the tuning-fork circuit and starts the time-marker vibrating on the recording drum; an instant later, say, .03 of a second, it closes a telephone circuit running to the reacting-room from the sound-room, thus producing the stimulus; it simultaneously breaks a current running through the registering signal on the drum and a closed key in the reaction room. This current is automatically closed again within .02 of a second, and again broken by the reaction on the closed key. As soon as the reaction takes place, the key is released and the tuning-fork curve stopped before the drum has made a complete revolution, thus saving all motion of the marker during the experiment, as well as space on the smoked paper. This not only saves much time, but also renders the records more legible and consequently more accurate.

CHARLES B. BLISS.

New Haven, Conn., Dec. 19.

Excitement Over Glacial Theories.

PROBABLY I have as much reason to be thankful for the frankness of Mr. McGee's letter in *Science* for Dec. 2, as for the courtesy of Dr. Brinton's previous review of my volume on "Man and the Glacial Period," for it doubtless gives expression to sentiments held by many persons in private, and it is better that I should have occasion to explain the misapprehensions which evidently prevail in some quarters. I beg, therefore, the privilege of your space for a brief statement of some points.

Mr. McGee refers to an apparent discrepancy between my observations on the rate of movement of the Muir Glacier and those of Professor Reid. If he had read Professor Reid's article carefully he would have seen that the discrepancy is more apparent than real. Professor Reid distinctly states that there was a quarter of a mile or more of width in the glacier which he was unable to reach with his stakes, and whose motion he therefore failed to measure, whereas by our method of taking angles directly upon the ice-pinnacles we were able to measure the portions which were presumably moving most rapidly.

As to my connection with the U. S. Geological Survey, the facts are that after I had, on the Pennsylvania Survey and at much private expense, mapped the glacial boundary from the Delaware River to Illinois, and published the results with considerable fulness, I was asked, in 1884, to complete the work to the Mississippi River for the U. S. Geological Survey and prepare a report on the whole line from there to the Allegheny Mountains. This I did, and the report was duly published in 1890. My formal connection with the Survey did not terminate until a month after the publication of my last book. I am not aware that any substantial error has been pointed out in my delineation of the southern border of the ice-sheet, which I was set to accomplish (see *The Dial* for Dec. 16, 1892).

The real point at issue relates to the question of the unity, or one might better say the "continuity" of the glacial period, and the disturbance all arises over the fact that I have been led to interpret the facts in accordance with the theory of glacial continuity, while Mr. McGee and some of his associates are committed to the theory that there were two or more distinct epochs. It is sufficient for me here to say that my conclusions are based on a large amount of field-work, and are supported by a respectable number of able geologists, and have recently been set forth at considerable length in an article in the November number of the *American Journal of Science*. In this I have not wholly disregarded Mr. McGee's science of geomorphy though I have not called it by that name.

Perhaps the best way for me to answer the charge of general ignorance will be to state in a few words the conception of the progress of events during the glacial period which I have been slowly led to entertain.

During the most of the Tertiary period the lands were low towards the pole and a warm climate prevailed. Toward the close of the Tertiary a slow elevation of these northern lands was in progress until they stood, say, 3,000 feet higher than now. This is shown by the fiords which characterize both sides of the continent from the latitude of Chesapeake Bay northward.

This elevation of land was probably the predominant cause of the glacial period, for the ice-movement in North America radiated, not from the pole, but from Labrador and the region about Hudson Bay. This elevation was accompanied by a rapid deepening of the river channels over the area and the consequent accumulation of detritus about their mouths.

Ice finally accumulated nearly a mile deep over the area north of the linemarking the "drift" and extending to New York City and Cincinnati. This accumulation of ice was coincident with, if not the cause of, a depression of the land in the more northern portions several hundred feet below its present level.

The final melting of the ice proceeded with great rapidity, but with various halts and oscillations of the front. The period of oscillation of the glaciers in the Alps is something like half a century. The periods during the great ice age were probably much longer, but a few centuries seems ample to account for the longest. These oscillations are marked by what Professor Cook aptly called "moraines of retrecession," of which there are twelve in Ohio.

Applying the principles of Mr. McGee's science of geomorphy, I explain the phenomena of slackened drainage which characterize the deposits along the extreme margin of the glaciated area as connected with the subsidence of the land increasing to the north, which marked the climax of the period, while the more vigorous signs of drainage action farther north are the natural results of the northerly re-elevation which went on synchronously with the unloading of the weight of the ice by melting. It is in these later stages of the deposition of ground that we find the remains of palæolithic man.

Whether this theory of the progress of events is correct or not,

it is based on wide observations of facts and long reflection on the elements of the problem, in which I have had the assistance and support of many able geologists, and they are views which cannot wisely be dismissed without careful consideration of the arguments upon which they rest. The theory is not without its difficulties; neither is any other. Geology is not an exact science. There is no infallible court of appeal for the settlement of theories. Observers and students of the facts may widely differ for a long time in their conclusions without discredit to either party. I can only ask for freedom of opinion and freedom of utterance.

G. FREDERICK WRIGHT.

Oberlin, O.

Notice of the Occurrence of Nyctale Richardsoni, Richardson's Owl, in Nebraska.

THE occurrence in this region of Richardson's owl, *Nyctale Richardsoni*, seems to be entirely established by the recent capture of one in Lincoln. This is a long distance below its southern limit, and its appearance is something of a surprise.

However, Professor Lawrence Bruner, who has stuffed and mounted this rare owl, noticed one as a boy, twenty four years ago, near Omaha. Ornithologists at the time questioned the accuracy of his observations, but this specimen confirms the probability of his claim.

The present specimen, which is the first actually taken in the State, was captured on 33d Street, in the city of Lincoln, Dec. 12, and was brought alive to the State Museum. It lived but a short time, however, owing perhaps to injuries, or to the heat. The bird is an adult, in fine plumage.

The unexpected appearance of this inhabitant of Arctic regions seems the more striking from the fact that the weather in Nebraska thus far, barring one snow-storm, has been a mild, protracted autumn rather than winter.

ERWIN H. BARBOUR.

University of Nebraska, Lincoln, Neb., Dec. 14.

Vagueness of Localization in a Child.

The following are illustrations of the vagueness of the localization of cutaneous sensations in children. The one referred to is 16 months old. The morning after she had been vaccinated, and for a considerable time afterward, she was unable to tell on which arm the sensitive spot was situated, often looking at or touching the wrong one. On one occasion the child sat down with her back close to a grate-fire; as soon as the heat had penetrated the clothing, she began pulling at and striking her chest as though the sensation were there.

M. SCRIPTURE.

New Haven, Conn.

Ballistic Galvanometer.

CAN any of your readers furnish me with complete references on the use of the ballistic galvanometer for measurements of time?

E. W. SCRIPTURE.

Yale University, New Haven, Conn.

BOOK-REVIEWS.

The California Vine Disease. By NEWTON B. PIERCE Bulletin No. 2. Division of Vegetable Pathology, U. S. Dep't. Agric. Washington, 1892. 222 p, pl. 25, charts 2.

Report on the Experiments made in 1891 in the Treatment of Plant Diseases. By B. T. GALLOWAY. Bulletin No. 3. Division of Vegetable Pathology, U. S. Dep't. Agric. Washington, 1892. 76 p. pl. 8.

Grasses of the Pacific Slope, including Alaska and the Adjacent Islands. By GEO. VASEY. Bulletin No. 13. Division of Botany. U. S. Dep't. Agric. Washington, 1892. 50 plates, with descriptions.

THESE three publications which have followed one another rapidly from the Government printing office are of diverse character. The first deals with the results of an investigation extending over two years into the character of an obscure but virulent disease of vines in California; the second records the results of a series of experiments to prevent the ravages of several plant-diseases in the eastern portion of the country; and the third gives descriptions and plates of fifty-two species of grasses found growing on the Pacific coast of our country, including Alaska.

The California vine disease seems to have first appeared in the vicinity of Anaheim, Orange County, in 1885, but it did not attract great attention until the following year, when it caused the death of a large number of vines. From this, its first appearance, it has spread over a wide section of the surrounding country and has caused the death of many thousands of vines and entailed a loss of many thousands of dollars. Mr. Pierce, as the special agent of the Department of Agriculture, had spent two years in studying the subject when the present report was submitted, in June, 1891, and since then has continued his investigations. The report is an exhaustive one in many respects, an unsatisfactory one in others. For example, while he has given a very full account of the rise and progress of the vine industry in California and Mexico, and has examined with great care the bearings of soil conditions and of meteorological phenomena on the disease, the remedy for the evil, or even suggestions for palliation of it, are meagre in the extreme. It might be said, it is true, that as the origin and cause of the disease is still unknown, it is not possible to prescribe a remedy. Everything that has so far been tried has given negative results. Numerous facts have been brought out by the investigation. Among them may be noted that drainage, irrigation, soil characters, rainfall, and temperature have had no effect in causing the disease. But that shade has in some unknown manner the effect of retarding the progress of the malady. It has also been ascertained that the disease is not caused by certain species of fungi or by certain animal or insect parasites, and that it differs in several ways quite markedly from Chlorosis and Pouritiore as these occur in Europe. The colored plates that are given illustrate very well the effects of the disease on the leaves and canes.

The second of the titles above given is an account of experiments conducted in the vicinity of Washington and in New York State for the prevention of plant diseases. These experiments bear out the previous work of the department. They show that, in the treatment of black rot of the grape, Bordeaux mixture still takes the lead; and that half strength, i. e , 3 pounds of copper sulphate, 2 pounds of fresh lime, and 22 gallons of water, gives as good practical results as full strength. In the treatment of apple scab, Bordeaux mixture was also very effective, but not so much so as Paris green. This is a new fact inasmuch as this substance, while known to be effective against insects, has not been generally supposed to be a fungicide. There was a higher percentage of first quality fruits and a less percentage of third quality as well as wormy fruits when this substance was used than any other. The experiments in New York were largely negative, since the amount of disease present was comparatively slight. The subjects treated were various kinds of nursery stock, and here again Bordeaux mixture gave as a whole the best results. Two plates showing sprayed and unsprayed grapes bear testimony to the good effects of the treatment for black rot.

The third title, "Grasses of the Pacific Slope," consists of illustrations and descriptions of grasses growing in California. Oregon, Washington, and Alaska. Some of them are of value for forage, while others are of scientific interest only. This is Part I. of the second volume of "Illustrations of North American Grasses," the first volume, also in two parts, having treated of the grasses of the south-west. The reports cannot fail to be of great interest and value to all students of botany.

JOSEPH F. JAMES.

Comparative Architecture. By BARRE FERREE. The author, New York.

THIS is a reprint of a paper read before the American Institute of Architects at its twenty-fifth annual meeting, at Boston, in October, 1891. It is handsomely printed in royal octavo, and covers fifteen pages in clear and pleasing type. In this discourse, the distinguished author applies to architecture the comparative method which has proved so fruitful in the study of language and of biology. "Comparative Architecture" takes "the facts of historical and descriptive architecture, and describes the comparative progress made by all nations, and under all conditions."

It is thought that thus "the rich results obtained by the comparative method in natural and human sciences justify the hope that not less valuable returns will be obtained" by this extension of the system. Architecture falls under the domain of law, and the immense walls of the Assyrians and the ponderous arches of the Romans are the product, not of fancy, but of the condition of environment of their builders. Mr. Ferree believes with Freeman; "Deal worthily with the history of architecture and it is worthy to take its place alongside the history of law and of language." "Comparative architecture has to do with architecture as the product of the human mind, as the result of intellectual processes and reasonings; and each day these things enter more and more into the making of modern architecture." The paper is well worthy of the careful perusal of the architect whether professional or amateur.

Energy and Vision. By S. P. LANGLEY. Washington, Nat. Acad. 18p. 4°.

THIS small volume contains, as is always expected of the papers of the distinguished astronomer and physicist, very important matter. The work was first presented to the National Academy of Sciences at its April meeting in 1888. It relates to the differing optical effects produced by waves of light of varying magnitude though containing equal energy. Two lines of research are marked out: the one to ascertain the quantity of energy in each ray; the other to measure the corresponding visual effect. In the first the "bolometer" of Langley is used to measure energy of various heat and light waves. Solar measures constitute the second. The result gives the value of equal amounts of energy at different points in the spectrum as affecting the retina. It was at once found that energy itself is not uniformly distributed in the spectrum. The gauge of energy was taken as the intensity of light required to read a table of logarithms; which method is thought more accurate than any of the usual photometric systems. It is found that the eye requires more time to regain its sensitiveness for violet light, after having been exposed to sunlight, than for any other color. It is found that the eye can perceive lights varying in intensity in the proportion of 1 to 1,000,000,000,000,000. The same amount of energy may produce 100,000 times as much effect in one portion of the spectrum as in another. Work done in giving rise to deepest red light amounts to about 0.002 erg per second

Spons' Tables and Memoranda for Engineers. By J. T HURST Eleventh edition. New York, Spon & Chamberlain

THIS is a little pocket-edition of Hurst's tables, and is likely to prove, as indeed the issue of eleven editions shows to be the fact, a very useful miniature reference-book. It is about one and a half by two and a half inches, and 140 pages of carefully selected tables and data, with a good index. It can be carried in the waistcoat-pocket. It is even smaller than the admirable little pocket-book published by the American Iron Works of Jones, Laughlin, & Co., and but a fraction of the size of Hurst's larger tables, of Molesworth, and other so-called pocket-books

AMONG THE PUBLISHERS.

— The tenth and concluding volume of the new edition of "Chambers's Encyclopædia" will be issued by J. B. Lippincott Co. in a few weeks. Mr. Stanley Lane-Poole writes on Swift and Turkey; Mr. F. T. Palgrave contributes the memoir of Tennyson and that of Wordsworth, Mr. Richmond Ritchie that on Thackeray. Sir W. Lawson treats of Temperance, Mr R W. Lowe of the Theatre, Mrs. Besant of Theosophy, and Mr. G. Howell of Trades-Unions. Mr. Hamerton is the author of the biography of Titian and of that of Turner, while Mr J. Gray writes on Van Dyck. The article on Anthony Trollope is by his brother, the late Thomas A. Trollope. Mr. Vámbéry writes on Turkestan, Professor Shaler on the Geology of the United States, Professor J. Geikie on Volcanoes, Mr. Austin Dobson on Horace Walpole, Mr. Loftie on Westminster and Windsor, Mr. Fraser

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Dec. 17.—Principal topic of the evening, What should be the Scope and Object of a Biological Society? introduced by Mr. B. E. Fernow. Communications: Lester F. Ward, Frost Freaks of the Dittany; Erwin F. Smith, Notes on Peach Rosette; M. B. Waite, Destruction of Lichens on Pear Trees; D. G. Fairchild, Notes on Apple and Pear Fusicladii.

New York Academy of Sciences.

Dec. 19.—W. B. Scott, Fossil Hunting in the North-West.

New York Academy of Sciences, Biological Section.

Dec. 12.—The following is a synopsis of the papers: On the Miocene Deposits of the White River, by Dr. T. L. Wortman. These deposits were arranged in three groups, Lower, or Menodus, beds; Middle, or Oreodon, beds; and Upper, or Protoceros, beds. The Protoceros beds were regarded as in part contemporary with the John Day beds of Oregon. On the Ilco-Colic Junction of Procyon lotor and Allied Arcthoids, by G. S. Huntington. The absence of caecum in Procyon was noted as repeating the condition found in Hyena and the Ursidæ. The provision for preventing return of contents of large intestine appears to consist in a series of constructions in the terminal part of the ileum together with increase in the circular muscular fibres in these situations as well as at the ilco colic junction itself. There is a complete absence of an ilco-colic valve. On the Origin of West Indian Bird Life, by F. M. Chapman. Conclusions from study of bird (and mammal) life were (1) distinctness geologically of Lesser from Greater Antilles; (2) independence of islands and mainland since the appearance of the present fauna; (3) original connection of Indes to Central America by way of Jamaica, Central America at this time an archipelago created by passage leading from Pacific to Carribean Sea; (4) the older faunal forms of the Indes represent survivors of the insular Tertiary species; (5) the newer forms are immigrants and become differentiated under new conditions of living. H. F. Osborn reported the discovery in the Miocene of South Dakota of a horned Artiodactyl represented by male and female skulls and complete fore and hind feet. The female skull is comparatively hornless and proves to be identical with Protoceras celer Marsh. The male skull exhibits no less than five protuberances upon each side, or ten altogether. Two of these upon the frontals and sides of the maxillaries are very small; the parietal, supra-orbital, and maxilliary protuberances are very prominent and hed, apparently, a dermal covering, as in the giraffe. There are four toes in front and two behind, as in the early Tragulidæ. The types were found by Dr. T. L. Wortman, and are in the recent collections of the American Museum of Natural History.

Society of Natural History, Boston.

Dec. 21.—W. F. Ganong, Some New Experiments on the Absorption of Liquids by Aerial Parts of Plants; S. H. Scudder, The Abdominal Pouch of Butterflies of the Genus Parnassius; W. H. Niles, Columnar Structure in Stratified Rock.

Publications Received at Editor's Office.

GEORGE, HENRY. A Perplexed Philosopher. New York, C. L. Webster & Co. 319 p. 12°. $1.

HALE, GEORGE E. Ultra-violet Spectrum of the Solar Prominences; The Yerkes Observatory of the University of Chicago; Some Results and Conclusions Derived from a Photographic Study of the Sun. Reprints. Chicago, The Author.

NEWTH, G. S. Chemical Lecture Experiments. London and New York, Longmans, Green & Co. 323 p. 8°. $3.

U. S. Navy Dep't Notes on the Year's Naval Progress. Washington, Government. 366 p., pl. 8°.

Rae on John Wilkes, Dr. Buchan on Wind, and Mr. Price Hughes on Wesley. Canon Isaac Taylor contributes the articles on Writing and on York and Yorkshire, and Cavendish that on Whist. Dr. Mills expounds Zend, and Mr. G. Saintsbury criticises Zola. The first volume of the new edition was issued in March, 1888, so that the work has been completed in less than five years — a very short time indeed when its magnitude is considered. The "Encyclopædia" contains over thirty thousand articles, contributed by nearly one thousand different writers, and includes among its contributors many of the chief authorities in various departments of knowledge.

— "Questions and Answers about Electricity," a small volume of 100 pages (50 cents) from the press of the D. Van Nostrand Company, is peculiar in some respects. It has four authors and one editor, and the latter, we fear, has taken undue liberties with the manuscripts of the authors. In no other way can we account for the presence of such words as "ampage," "furtherest," "shellaced," etc.; and such statements as, when cells are connected in multiple, the current can travel "only a few feet." Though intended specially for amateurs and students, we fear the book will prove more interesting to those "well up" in the subject. A glossary, by the editor, no doubt, adds to the originality of the work.

— "The Sloyd System of Wood-working" is the title of a 250-page volume from the pen of B. B. Hoffmann, A.B., superintendent of the Baron de Hirsch trade-schools, and just published by the American Book Co. (Price $1.) The book gives an excellent account of the theory and practical application of the Naas system of manual training, which has already received considerable attention in the volumes of *Science*. The first two chapters of the work give the clearest and most comprehensive exposition of the system we have seen; the third chapter (some things in which might better have been omitted for common-school purposes) gives a history of the manual training idea; the final chapters give an account of various model series and of the progress of the system in elementary schools.

—The D. Van Nostrand Company have just published "The Practical Management of Dynamos and Motors," by Francis B. Crocker, professor of electrical engineering in Columbia College, and Schuyler S. Wheeler, D.Sc. To the man in charge of an electric light or power plant this volume will prove invaluable, as it is the first book, as far as we know, devoted specially to their requirements. It gives simple and readily comprehended instructions in the practical use and management of dynamos and motors. The different subjects are treated separately and in logical order, and are arranged so as to facilitate ready reference on any point on which information is desired. ($1.)

— Metal-Coloring and Bronzing" is the title of a new 12mo volume of 336 pages just issued from the press of Macmillan & Co. (Price $1.) The book is the result of experiments and investigations carried on for eighteen months by Arthur H. Hiorns, principal of the metallurgy and engineering department of the Birmingham (England) municipal school; and is, we believe, the first systematic treatise on metal-coloring (more commonly known as bronzing) that has been published. The essential portion of the work is treated under three principal divisions, namely, chemical, electro-chemical, and mechanical metal coloring, the first being given greater space on account of its greater importance. The introductory portion contains a brief account of the properties of the ordinary metals and their chemical relations with regard to oxygen, sulphur, chlorine, etc.; and also deals with the chemical effects of the atmosphere on metals, the relation of metals to color, and chemical principles and changes. The rest of the volume is devoted mainly to the mechanical processes employed. As an authority on metallurgy the author of this work is well known; and this, with the fact that the book is the first in its peculiar field, insures for it a secure place in technical literature.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale or suitable exchange.—A spectrometer made by Fauth & Co., Washington, D. C., according to the plan of Prof. C. A. Young. This instrument is suitable for the most advanced investigations and determinations. Cost originally $700 and has been used but little. Will be disposed of at a considerable reduction. Address Department of Physics, Ohio University, Athens, O.

I will send British land and fresh-water shells in return for those of America, any part, sent to me. I have at present about fifty or sixty species, with many varieties. W. A. Gain, Tuxford, Newark, England.

The Biological Department of Hamline University desires to offer microscopic slides of animal tissues, or whole animals, in exchange for first-class fossils. Address correspondence to Henry L Osborne, Hamline University, Hamline, Minn.

For sale.—A set of the Berichte der Deutschen Chemischen Gesellscaft, from Jan. 1, 1877, to Jan. 1 1892, bound in twenty-six volumes to Jan. 1, 1888 and remaining four years unbound. Also the Bulletin de la Société Chemique de Paris, from Jan. 1 1879, to Jan. 1. 1892, bound in eighteen volumes to Jan. 1, 1888, and remaining four years unbound. Dr. Marcus Benjamin, care of D. Appleton & Co., 1 Bond St., New York City.

For sale.—1,500 bird, and 125 mammal skins, which are first-class and labelled with strictly reliable data. They were collected in this immediate vicinity and are preserved and made up according to the latest approved methods. As I offer the above at a very low price, it would be a good opportunity for a college or a museum. Willard E. Treat, East Hartford, Conn.

For Sale.—A new Model U. S. Army Hospital Microscope (Zentmayer), also 1/6-inch and 1 1/6-inch Objectives. HENRY C. WELLS, 151 Broadway, New York.

Wants.

WANTED.—American Journal of Conchology, seven volumes. Parties having these for sale will please address the undersigned, stating condition and price. R. Ellsworth Call, Louisville, Ky.

A GRADUATE ENGINEER will give instruction evenings in geometry, trigonometry and surveying, mechanics, physics, mechanical drawing and general engineering construction. Five years' experience in field and editorial work on engineering journal References furnished C. S. H., 102 Tribune Building, New York.

A POSITION is desired in the South, preferably the Gulf States, where I can teach the sciences. Can also instruct in other branches. Salary only nominal, as I am simply desirous of employment while spending the winter in the South. A private family preferred, but will accept regular school work if not too confining. MORRIS GIBBS, M.D., Kalamazoo, Mich.

WANTED.—By well-qualified and experienced science master and associate of the Royal School of Mines, London, aged 26 (at present in England), a mastership in technical college or university for any of the following subjects: Engineering sciences geology and mineralogy, physics, chemistry and metallurgy, etc., etc. Can provide excellent references and credentials. Apply, J. G., 17 Sussex St., Rochdale, England.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems fossils shells archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Hortter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.

TO THOSE INTERESTED IN SCIENCE.

[Science (weekly) established in 1883, N. D. C. HODGES, 874 Broadway, New York City.]

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Bird on Its Nest, The.
Birds Breeding at Hanover, N. H.
Botanical Laboratory, A.
Botanists, American and Nomenclature.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diamonds in Meteorites.
Diphtheria, Tox-Albumin.
Dynamics, Fundamental Hypotheses of.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers Association.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, New Method of Protecting Buildings from.
Lion Breeding.
Lissajou's Curves, Apparatus for the Production of.
Maize Plant, Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
Patent Office Building, The.
Physa Heterostropha Say, Notes on the Fertility of.
Pict's House, A.
Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
Psychological Laboratory at Toronto.
Psychological Training, The Need of.
Psylla, the Pear-Tree.
Rain-Making.
Rice-Culture in Japan, Mexico and the United States.
Rivers, Evolution of the Loup, in Nebraska.
Scientific Alliance, The.
Sistrurus and Crotalophorus.
Star Photography, Notes on.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Weeds, American.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

Aaron, Eugene M., Philadelphia, Pa.
Allen, Harrison, Philadelphia, Pa.
Ashmead, Albert S., New York City.
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Bolles, Frank, Cambridge, Mass.
Bostwick, Arthur E., Montclair, N J.
Bradley, Milton, Springfield, Mass.
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Chandler, H., Buffalo, N.Y.
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Conn, H. W., Middletown, Conn.
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Hale, George S., Boston, Mass.
Hale, Horatio, Clinton, Ontario, Canada.
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Haworth, Erasmus, Oskaloosa, Iowa.
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Hitchcock, Romyn, Washington, D.C.
Holmes, E. L. Chicago, Ill.
Hoskins, L. M., Madison, Wis.
Hotchkiss, Jed., Staunton, Va.
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Howe, Jas. Lewis, Louisville, Ky.
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Osborn, Herbert, Agricultural College, Ames, Iowa.
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Riley, C. V., Washington, D. C.
Ruffner, W. H., Lexington, Va.
Sanford, Edmund C., Clark Univ., Worcester, Mass.
Scripture, E. W., Clark University, Worcester, Mass.
Seler, Dr. Ed., Berlin, Germany.
Shufeldt, R. W., Washington, D.C.
Slade, D. D., Museum Comp. Zool., Cambridge, Mass.
Smith, John B., Rutgers Coll., New Brunswick, N. J.
Southwick, Edmund B., New York City.
Stevens, George T., New York City.
Stevenson, S. Y., Philadelphia, Pa.
Stone, G. H., Colorado Springs, Col.
Taylor, Isaac, Settrington, England.
Thomas, Cyrus, Washington, D. C.
Thurston, R. H., Cornell University, Ithaca, N.Y.
Todd, J. E., Tabor, Iowa.
True, Frederick W., Nat. Mus., Washington, D.C.
Turner, C. H., Univ. of Cincinnati, Cincinnati, O.
Wake, C., Staniland, Chicago, Ill.
Ward, R. DeC., Harvard Univ., Cambridge, Mass.
Ward, Stanley M., Scranton, Pa.
Warder, Robert B., Howard Univ., Washington, D.C.
Welch, Wm. H., Johns Hopkins, Baltimore, Md.
West, Gerald M., Clark University, Worcester, Mass.
Whitman, C. O., Clark University, Worcester, Mass.
Williams, Edward H., Lehigh Univ., Bethlehem, Pa.

SCIENCE

NEW YORK, DECEMBER 30, 1892.

VANDALISM AMONG THE ANTIQUITIES OF YUCATAN AND CENTRAL AMERICA.

BY M. H. SAVILLE, ASSISTANT IN PEABODY MUSEUM, HARVARD UNIV., CAMBRIDGE, MASS.

THE ancient buildings and sculptures of Yucatan and Central America have within a few years been much damaged and disfigured by the indifference of the natives of those countries, and by the vanity of travellers, some of them unfortunately American, who paint their names in large characters on the sides of the buildings and carve them on the sculptures.

Briefly, I will enumerate a few instances that have come under my personal observation.

The magnificent "House of the Governor" in Uxmal, probably the grandest building now standing in Yucatan, is almost covered with names on the front and on the cemented walls inside. These names are painted in black, blue, and red, and the letters are in some cases twelve inches high, and here are to be seen the names of men who are widely known in the scientific world. The "House of the Dwarfs" in the same city has suffered in a like manner. Many of the sculptures which have fallen from the buildings in Uxmal have been wilfully broken, and I noticed particularly that two of the beautifully carved turtles from the "House of the Turtles" had been broken apparently by a machete.

The large face figured by Stephens in "Incidents of Travel in Yucatan," Vol. II., p. 434, is in a mound in the backyard of a shop in Izamal. This has been almost destroyed. The whole of the face between the eyes and the lower part of the chin is gone, and I was told that the stones thus obtained were used in repairing a fence. On the other side of this mound is the bas-relief in stucco discovered by Charney, and this is slowly crumbling away. The steps leading up to the top of the Great Pyramid are being thrown down; and many mounds in Yucatan are being destroyed at the present time to furnish building material. In fact, if a bee's nest should be found in one of the old buildings, the Indians would tear down part of the structure to get at the honey.

In Copan, when the Peabody Museum Honduras Expedition compared the condition of the "Idols" to-day, with the photographs taken by Mr. A. P. Maudslay seven years ago, it was found that during that time some of the very finest sculptures had been disfigured by blows from machetes and other instruments. The Stela given as a frontispiece in Stephens's "Incidents of Travel in Central America," Vol. I., has been much marred by some one who has broken off several ornaments and a beautiful medalion face from the northern side. One of the faces and several noses have been broken off from the sitting figures on the altar figured by Stephens in the same volume, opposite page 142. On some of the idols and altars names have been carved, notably on the back of the Stela figured opposite page 158 in Stephens, and a large fragment has been broken from the same Stela. While excavating in one of the chambers of the Main Structure we uncovered a beautiful hieroglyphic step, but before we had time to secure a photograph of it, some visitor improved the opportunity while no one was about to break off one of the letters.

In Quirigua a small statue, discovered by Maudslay and removed by him to a small house near the rancho of Quirigua, had the head and one of the arms broken from it during the interval between two visits. This statue was of the highest importance, as it very much resembled the celebrated "Chaac-mol" now in the Mexican Museum, but discovered by Le Plongeon at Chichen Itza. One of the Stelæ at Quirigua has had a name carved on it quite recently; but the sculptures of this place are in a much better state of preservation than those of Copan owing to their being at some distance from the road, and being covered with a dense tropical growth; while those of Copan are within a mile of the village, and there was formerly a road over the Plaza Grande and among the idols. The burning of the bush, to clear the land for milpbas, has also injured many of the sculptures owing to the cracking of the stones by the heat.

While in Nicaragua I learned that the sculptures on the Island of Zapatero in Lake Nicaragua have within a few years been much broken and disfigured. These were described by Squier in "Nicaragua, Its People, Scenery, Monuments, etc.," Vol. II.

As the governments of Mexico and the Central American republics are making little or no effort to preserve or care for the antiquities within their boundaries, it remains for the United States to do something to preserve these vanishing memorials of the past. The initiative has been taken by the Peabody Museum, Cambridge, which has been granted, for ten years, the care of the antiquities of Honduras. A wall has been built enclosing the principal remains in Copan, and a keeper been placed in charge with strict orders to allow nothing to be destroyed or carried away. Thus a strong effort is being made by the Peabody Museum to protect the wonderful carvings in stone of the ancient city of Copan.

ANCIENT JAPANESE CLOCKS.

BY FRANK D. SKEEL, A.M., M.D., NEW YORK.

THE ancient Japanese, in common with most Oriental nations, measured time by the position of the sun. Their day commenced and ended with sunrise. As Japan lies between the thirtieth and the forty-fifth parallels of latitude, the days and nights vary considerably in length during the year. To fulfil the conditions of their notation a timepiece must divide into equal parts the periods of daylight and the periods of darkness. To construct a timepiece which will perform this erratic division of time is a mechanical problem of no mean order. This, the ancient Japanese have accomplished in several very ingenious ways.

Their clocks may be roughly divided into two general classes:—

1. Those with a constant rate, in which the changing length of the hours is indicated by the spacing of the numerals, which are engraved on movable pieces of metal.

2. Those with a varying rate, having the numerals equally spaced, the length of the hour being regulated by the rate of the clock.

Under the first division there are two types, namely, clocks with rectilinear dials, and clocks with circular dials. Clocks of the former type are driven by a weight or a spring. Those of the second type by weight only. The power is transmitted by a cord or chain to which, in clocks with rectilinear dials, the index is attached. The hour-signs are engraved on separate pieces of metal, which slide in a vertical groove in the front of the case. Parallel to this is a slit in the case, through which the hand is attached to the cord. The hours of day and of night are indicated by different characters. The spaces between these signs are regulated by moving the pieces of metal bearing the hour-signs nearer together or farther apart as occasion may require. Some clocks of this type are provided with graduations and a table by which the hour-signs may be properly adjusted in accordance with the season of the year. The hand moves downward over the face of the dial as the clock runs down and resumes its place at the top when it is wound. The escapement is the verge, with crown-wheel, balance-wheel, and hairspring. The driving-power is either a weight or a spring, as before stated.

In some weight-clocks the striking-train and bell comprise the driving-weight. The striking mechanism is released by pins projecting from the back of the little plates carrying the hour-signs. These pins trip a small lever as the train passes. Clocks drawn by a spring have the spring-barrel located in the lower part of the case.

A clock of this type in my possession has the general appearance of a hall clock of our grandfathers' days except for its diminutive size. It is eight inches high, three-fourths of an inch deep, and one and one-fourth inches wide. The case is beautifully made of dark wood. The upper part of it, enclosing the works, has glass front and sides, the cap over the balance-wheel, as well as the front plate of the works, which are of brass, is open-work of graceful design and is gilded. Another clock of this type, also in my possession, is still more diminutive in size, being only three and three-fourths inches high, one-fourth inch deep, and three-fourths inch wide. It is made entirely of brass except the numerals, which are of silver, and is beautifully engraved and gilded. At the bottom of the case there is a small compartment closed by a hinged door. This contains the key. The numerals are fitted into a dovetail groove in the front of the case, and the hand is carried on a sliding piece attached in the manner before mentioned to the fusie chain. There are no divisions to indicate the fractions of the hour.

Another interesting example of this type has a dial engraved with a series of logarithmic curves. On the faces of these clocks there are two rows of characters: when the dials are rectilinear, the characters are arranged in two vertical columns; when circular, in two concentric circles. These rows are some little distance apart, and the characters are unequally spaced. Each numeral is connected to its opposite one by a logarithmic curve. The space between the columns is divided into twelve equal parts by parallel vertical lines, each line having at its upper extremity the sign of a month. The space included between the intersections of one of these lines with two successive logarithmic curves, will indicate the length of the corresponding hour for the first day of the month which is indicated by that line. In this clock the index is borne on a cross-bar, which extends across the dial from one column to the other and is attached to the weight-cord. The index is so affixed to this bar that it can be moved along its length, thus passing from one line to the other as the months elapse. When this kind of clock is provided with a circular dial, the logarithmic curves are laid out in the same manner and intersected by parallel concentric circles. The hand moves over the dial and is constructed so as to slide through its attachment to its arbor, thus being lengthened and shortened.

Another clock of this type has a much more complicated structure. Its circular dial revolves and is furnished with movable hour-signs, which are arranged in concentric circular grooves on its face. A pin projecting from the posterior face of each opposite hour-sign enters the groove in a slotted arm which extends across the back of the dial. These arms are acted upon by an eccentric, which in its turn is driven by a train of wheels completing its cycle in a year. The action of this mechanism is such that the opposite ends of the arms and consequently the hour-signs are separated and approximated as the days and nights vary in length.

It only remains to describe the clocks of the second class, viz., those in which the rate is made to vary in accordance with the seasons. None of these clocks, as far as I am aware, have the balance-wheel and hairspring, but they have its forerunner and immediate ancestor, the escapement of Huygens, which consists of a vertical staff suspended by a fine silk thread attached to its upper end. This staff is provided with lugs which engage the teeth of a crown-escapement wheel, and it bears a horizontal arm from which small weights are suspended like a scale-beam. The rate of the clock is regulated by the adjustment of these weights. In general form, these clocks are rectangular or cube-shaped. The gong is placed on top of the case. The dial is circular and revolves from right to left, the hand being stationary. The case is of brass and is usually highly ornamented. The variation of rate in these clocks is accomplished in two ways, viz., (1) *entirely* by the adjustment of the weights borne on the arm of the escapement, and (2) partly in the foregoing manner and partly by the mechanism itself; the latter form having a double escapement, which will be described later.

The specimen of the former kind which I have is two and one-half inches wide, two and one-half inches deep, and seven inches high over all. The case is of brass, and is beautifully ornamented by chasing, and the wheels, which are cut by hand, are very accurately made. The characters are engraved on the dial in two circles, the outer one being composed of the signs of the Chinese Zodiac, and the inner one, of the hour-signs. Below the dial, on the face of the clock, are two openings, through each of which may be seen an astrological character. These characters change once in twenty-four hours. The weight-cords run over spiked pulleys and have small counter-weights. The clock has a striking-train and a going-train.

Another clock of this form in my possession is of more complicated construction. It has two escapements, the horizontal arms of which are of different lengths. In this clock the variation of rate is accomplished partly by hand and partly by the automatic operation of the mechanism itself. One escapement remains idle during the day and the other during the night, the staff of one being lifted from its engagement with the escapement-wheel at the same time that the other is brought into gear. This is accomplished by two levers which lie directly below the ends of the vertical staves of the balance. The opposite ends of these levers are acted upon by two cams on the same arbor which cause one of them to rise and the other to fall at the proper moment.

I have omitted to say anything of the fantastic astrological meanings of the various characters found on these clocks and of the intimate connection between the astronomy, astrology, and horology of the Japanese, and will only add that if they are children in imagination they are certainly giants in mechanical execution.

In writing this article I have availed myself of the articles written by Emil James, Journal Science D'Horology, Vol. VIII.; Aneè and Thomas Eggleston, Ph.D., in the School of Mines Quarterly for July, 1882.

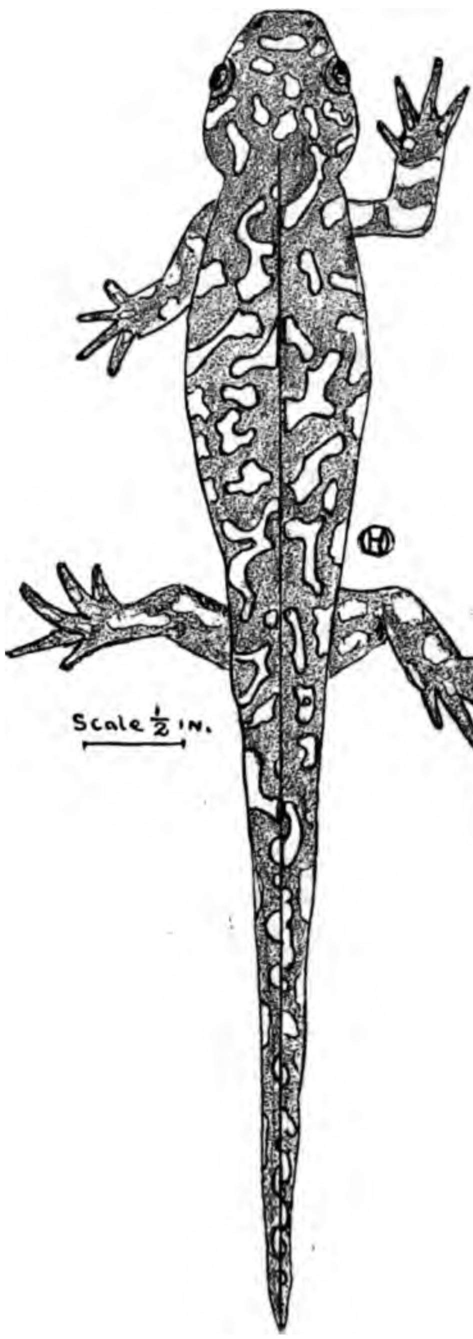
SOME BIOLOGICAL NOTES ON AMBLYSTOMA TIGRINUM I.

BY HENRY LESLIE OSBORN, PH.D., ST. PAUL, MINN.

THERE is a salamander, most probably of the species named above, which is very common in this vicinity. In the autumn months, especially during September, it can be found abundantly in cellars or in damp, dark, or semi-dark places about buildings. I have often seen it on the railroad tracks imprisoned between the rails, and many specimens which had been run over and killed by the cars can be found at this season. Occasionally they are seen creeping about on the walks or in the grass, where they are frightened by man's approach and run actively away. They are familiarly called lizards, and the use of that word among the people of this vicinity can almost always be understood to refer to this animal. It lives in aquaria for an indefinite time, remaining on the bottom, and coming to the surface for renewal of air of the lungs rarely.

1. The *markings* of this salamander are vivid yellow spots upon a ground of brown-black upon the back, giving place to faint bluish ground and lighter color on the ventral surface. There is a very great deal of variation in the shape and distribution of the spots. In general, they are irregular, elongate figures of various sizes from very small rounded ones up to those of considerable size, whose length may be equal to half an inch. The directions of the long ones of the spots are not the same, while they are chiefly antero-posterior, some are oblique from behind, forward and inward, while others are oblique from behind, forward and outward. The patterns of the two sides are not "mated," they are entirely independent. Not only so, but there is a distinct line which separates them, and in the middle a black line often cuts directly through the spots, so that, while they meet, they do not match. This last-named condition is very noticeable in the tail, as shown in the accompanying figure. It is very conspicuous in many cases, but perhaps less noticeable in specimens

not so largely spotted as the one used in making the figure. This absence of bilateral symmetry in the skin markings is a more or less general phenomenon in the coloration of animals; they rarely having their two sides perfect counterparts. It is in fact a case of a general law, applying to all bilateral organs, perfect bilateraling being a very rare phenomenon, due, on modern biological views, to the preponderance of growth in the cells of one organ over its homologue of the opposite side through the operation of any of the several causes which influence vitality



of cells, e g., use, nutrition, disease, perhaps inheritance. But, in animal coloration, while perfect bilateraling of marking is unusual, and a certain independence of the opposite sides is usual, it is rarely carried so far as here. The markings of birds. etc., blend across the middle line, so, too, the blotches of snakes, frogs, and other familiar cases, and I have never seen an animal in which the independence of the color markings of the two sides is as pronounced as it is in this form. A fact of this kind would appear to have some important suggestions in relation to the ontogenetic history of the yellow color producing cells. If they are separated early in their history and continue distinct, we should expect such a separation in their ultimate products. There are facts enough to indicate that in lower forms, such as annelids, the cells of the two sides of the body in many of the organ systems are separate from an early date, even as early as in the early segmentative stage of the egg (cf., E. B. Wilson, "The Cell Lineage cf Nirus," *Journal of Morphology*, vol. vi., p. 36, 1892). This supposition would not be out of accord with the fact that the independence of coloration is found in a lower rather than one of the higher animal groups and in a lower member of its group, for it is the characteristic of the higher forms to have more and more intimate relation of parts. The distribution of the color-spots I cannot as yet reduce to any law by study of adults, and I know of no observations in the embryology of Amblystoma which have been directed upon this point. There seem to be some faint suggestions of metamerism in the coloration of the area of the side walls of the body, especially between the limbs. The body wall in this region is marked on the ventral aspect and laterally by rings (Myotorms), which correspond with the attachments of the muscle fibres, and the color spots are rather noticeably located upon the rings rather than on the spaces between them. The rings look like somites of an annelid, and it would be interesting to know if they correspond with the segmentation of the vertebræ and nervous system.

2. The *movements* and *locomotion* of the salamander are very interesting to observe. They suggest an animal which is passing from the use of the back-bone and its curvatures as a mechanism for locomotion to the use of limbs. The locomotive movements are of two classes, the first are those performed under ordinary circumstances, the second those performed to escape from a pursuer, as when one attempts to seize the creature. The former are made by means of a combined use of the back-bone, which is thrown into gentle curvatures, and the legs, which are the chief instruments in the act. The curvature of the back-bone is such as to throw the limb to be used forward further than it would be with the spine kept straight. The limbs are used in strict alternation, the right front leg and the left hind leg going forward together, and then backward together, while the spine has a convexity toward the right in the brachial region and toward the left in the sacral region. The creature, in water, when disturbed by one's hand generally either makes a disorderly scramble with the limbs, which has but little result, or it swims swiftly with a truly fish-like sinuation of the body, including the large post-anal region or "tail," which is much compressed and forms a very efficient organ of swimming. It has seemed to me that this swimming motion may be a case of physiological reversion. We know that the vertebral musculature is far more ancient phylogenetically than the limb musculature, and we may suppose that hence the power to control it nervously is far greater than that to control the more recently acquired limb musculature. It is a case of the tendency to fall back on the ancestral mode of action so long as the structure will permit, especially under circumstances in which the animal is under the influence of strong excitement, which would tend to weaken the more recently acquired powers and allow the ancient lines of habit to become dominant. This tendency can be discerned in many other cases; thus, for instance, I regard the case of the crayfish as precisely similar to the one just cited. It commonly moves by a walking motion, not using the flexion of the abdomen, but under excitement of escape it reverts to this ancestral action, and the familiar "crawfish" movement results. I do not think it is at all beyond the range of reason to include the tendency of people to lapse into a native language from an acquired one in moments of excitement under the same principle of physiological reversion. In this connection, I may speak of a specimen of *Necturus*, which I had for some time in an aquarium in the laboratory, in which the swimming movements were even more noticeable than in the salamander, a fact co-ordinated with its more piscine peculiarities in other respects.

It is possible to discover in the movements a suggestion of the origin of limbs. The limbs are usually in a line, and the front right leg is thrown forward by the curvature of the body at the same time that the left hind leg is thrown forward by the curvature in its level. Limbs at these points, if at first mere stumps,

would be of advantage by the hold they would give to the squirming body. Then elongation would increase the advantage. No loss of this function would be necessary, but a gain, if the limb acquired some independent motion, and this might be developed enough to render it capable of officiating as the sole locomotive organ. If such a history of the limb were true, the salamander is midway in the line of descent.

3. The *post-anal region* of the salamander is piscine, while the anterior portions of the body are not, but are distinctly higher. This fact is more or less familiar in a general way and called by Professor Hyatt, who pointed it out many years ago, by the name "cephalization." This advance of the anterior part of the body of the salamander has left the "tail" to be in many respects not amphibian so much as piscine. Of course the term tail here means post-anal region of the body and the portion, roughly speaking, homologous with the post-anal region of the fish. In the higher fishes this region has acquired a "tail," while the amphibia have not shared the acquisition of a structure supported by five rays, which does not belong to the ancient vertebrate stock. In this sense the tail of the salamander and its correlate, the post anal region of the fish, are not only similar in function, being organs of locomotion, but they are comparable in their anatomy. The back-bone is acentrum with bi-concave surfaces with two equally developed arches, a neural arch containing the spinal cord, and an haemal arch containing a vein and an artery with oblique intervertebral muscles forming the back of the organ. In vertebrates above the urodela, with the loss of its locomotor function and the development of arms and legs, the post-anal region becomes of less and less importance, though not always disappearing; thus in many lizards it is large at its origin, as large as the body before it, and it has the peculiar power of *autotony*, as it has been called; that is, of breaking off in the hands of a captor, whereby the animal escapes capture. There is a gradual degeneration of the region among the higher vertebrates, with many varieties of direction and degree of development and occasional utilities in peculiar directions, and the salamander stands at the bottom of this series.

4. The *death of the salamander* is accompanied by a loss of powers of movement, which is first manifest in the last acquired (phylogenetically) of the powers, i.e., in the limbs, and finally in the vertebræ muscles. In specimens killed under the influence of chloroform, after all movement had ceased in the limbs, the sinuations of the back-bone continued for some time, and were the last movements observed to take place.

REFLEX ACTION IN TURTLES.

BY M. J. ELROD, ILLINOIS WESLEYAN UNIVERSITY, BLOOMINGTON, ILL.

RECENTLY I had a number of map turtles (*Malaclemys geographicus* Le Sueur) for student work, and observed, what is to me, a remarkable instance of reflex muscular action, both in the head and limbs. In one specimen the head had been severed from the body fully an hour, when I observed the students amusing themselves by tapping the nose of the severed head, when almost as quickly as in life the jaws would open, and when a pencil or other hard object was thrust in would close upon it with seemingly as much viciousness as in life, continuing to hold for some time, gradually relaxing, when the experiment would be tried over again. This was the case not only with the one in question, but with a half-dozen others of the same lot. Taking a specimen with the head cut off and all the viscera cleared away, leaving the legs attached to the carapace, the legs manifested sensitiveness to a marked degree. In one specimen the four legs extended from the body almost straight; a very gentle touch with the point of a pencil on the tip of a claw caused that leg to be drawn within the shell, so to speak, as quickly as in life. This was done alternately with each foot to the first again, all giving the same results. Several other specimens tested showed as much and as sudden movement, and one killed at 2 P.M., when touched at 11 A.M. the day following, withdrew its feet instantly. While these observations are common for turtles, I have not observed such marked results in other species.

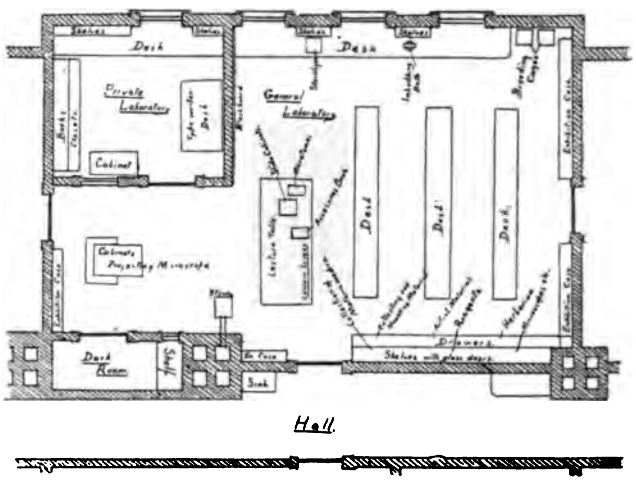
A LABORATORY OF PLANT DISEASES.

BY C. W. WOODWORTH, BERKELEY, CAL.

THERE has recently been equipped at the University of California a laboratory for the study of the subject of plant diseases in its broadest sense; and, as there are but few if any others where the whole subject is taught as a unit, it may be well to give an outline of the equipment for this class of work.

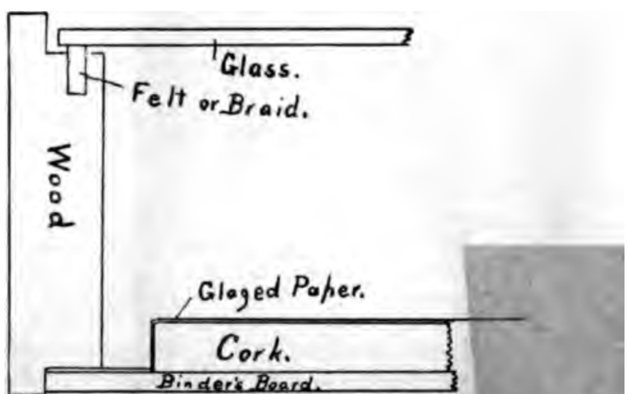
We will not consider that part of the equipment for this work afforded by the grounds, orchard, nursery, gardens, and greenhouses of the agricultural department, but confine ourselves to the laboratory proper. The subject of plant diseases is now, and will continue to be, associated with that of entomology, so that the same equipment, to a considerable extent, serves for the two subjects.

The laboratory-room is something over twenty by thirty feet, and is situated on the north side of the Experiment Station building. It is lighted by four windows, having an entirely unobstructed view, and so giving ample light for microscope work. A corner of the room is partitioned off for a private laboratory, and a closet is fitted with a ruby window, affording an opportunity for photo and blue-print work. The figure below will give a good idea of the arrangement of the room.



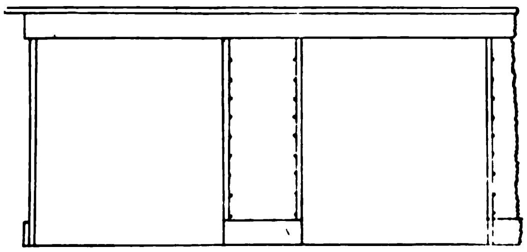
The windows are all fitted with heavy shades working in grooves, enabling one to darken the room very easily and quickly when the lantern is to be used for illustration. The views are projected on a screen of tracing-cloth, which is mounted on an ordinary spring-roller and is ordinarily rolled up out of the way.

Besides the benches near the windows, which are used by advanced students, there are also three long desks, one and a half feet wide by twelve in length, that have proven themselves so convenient that a sketch of one is presented. As can be seen on the plan, these are so constructed that at the side of each student boxes, the size of those of the collection, may be used as drawers, or boards may be inserted forming shelves.



The boxes used for the collection are made as shown in the accompanying figure, and are from their peculiar construction not liable to warp or crack, and so remain perfectly

The cloth bearing for the glass is treated with corrosive sublimate, and the paste and glue used are arseniated. These boxes are kept in cabinets, the glass doors of which are fitted with a rabbited groove on all four sides, thus making them also dust- and insect-proof.



The collections kept in these cabinets are arranged in three series. Series one is the systematic collection, where the organisms producing injuries to plants are grouped in the ordinary order, beginning with mammals and ending with the higher plants. The second series is the "host" collection, where the various plants are taken up in an agricultural order, as, for instance, seed crops, fruit crops, etc., and the injuries to each particular crop illustrated. In the third series, the symptomatic collection, all diseases having a common symptom are brought together, thus all galls and distortions from whatever cause or on whatever plant are assembled and classified.

Besides these there are the beginnings of a cryptogamic herbarium in drawers and a collection representing the materia medica of plant diseases.

There are in the laboratory a sterilizer and all the other necessary apparatus for this class of bacteriological work. For microscopical and histological work there is also a good equipment including paraffin bath, microtome suitable for the highest grade of work, compound microscopes and accessories, and a very good outfit of reagents.

All reagents, as far as possible, are kept in standard strengths, and the bottles marked to serve as graduates for dilution. Thus the chromic acid is made up in a large bottle into a 5 per cent solution. The 1 per cent solution is made by filling the bottle to contain it to a mark and adding water. Most of the chromic mixtures are made from the one per cent. The chromic-acetic killing mixture, for instance, is made, as is indicated on the label, from one-half per cent chromic acid to the first mark, 95 per cent alcohol to the second, and 10 per cent acetic acid to the neck. Mixtures liable to deteriorate are kept in small bottles, and such as the acid-alcohols for decolorizing are not kept mixed at all, but large homo vials are properly labelled and the mixtures made up as used

This sketch gives merely the present condition of the laboratory, it is expected that apparatus will be added from time to time as opportunity offers and as it is needed for the work in hand; indeed, there is considerable new apparatus at the present time being constructed for the laboratory.

AN IMPORTANT COLLECTION OF MOLLUSCA.

BY HENRY A. PILSBRY, ACAD. NAT. SCI., PHILADELPHIA.

IT is not generally known, even among specialists, that one of the most valuable and most instructively arranged collections of Mollusca in America, is that which Professor Henry A. Ward has brought together at Rochester, N.Y. This collection the writer has recently had an opportunity to examine, and it is believed that some account of it may be useful not only to specialists in Mollusk morphology, or conchologists desiring to see rare shells, but also to those who look upon a collection especially as an instrument of education for class or public use.

The primary idea of Professor Ward's collection is to give the spectator not only a comprehensive but a *comprehensible* view of all phases of Mollusk life; and to this end a number of the more typically developed forms of each genus have been selected for exhibition. The practical advantage in limiting the number of species representing each genus will be readily admitted by those who have observed the effect, on the non-scientific observer, of the vast wilderness of similar species exhibited in some of the public museums of our large cities.

A further purpose has been to procure the best specimens obtainable of each species represented, and to select not merely the rare and beautiful, but, before all, species and specimens which have a life history worth knowing, and can tell it themselves.

The dry specimens of shells are contained in horizontal glazed cases disposed around the sides of two rooms,— in all, about 220 linear feet of cases. Wall-cases behind them contain alcoholic Mollusks, and drawers below hold additional species. The specimens are mounted upon light wooden tablets, appropriately colored, and made by gluing two pieces together, crossing the grain to prevent warping. Labels for families and higher groups are printed, and in most cases contain a concise statement of the fundamental characters of the group. The shellless forms, such as most Cephalopods and the *Nudibranchiata* are represented by Blatschka's beautiful models, now, alas! no longer obtainable.

A few hasty notes upon some of the specimens may be of interest. Upon entering the outer room one sees suspended from the ceiling a life-size model of the gigantic Squid (*Architeuthis*) of the North Atlantic, its suckered tentacular arms thirty feet in length. The actual existence of such monsters almost makes us forgive old Denys de Montfort for his picture of a "Poulpe Colossal" dragging down a full-rigged ship! The first horizontal cases contain shells of the Paper Nautilus; then several species of the Chambered Nautilus. A specimen of the animal of the latter (*Nautilus pompilius*) in its shell is one of a very few in America; though the shells are not uncommon, this remnant of a Palæozoic and Mesozoic race is rarely found in the flesh. The pelagic Pteropods are arranged after the Cephalopods, and then the air-breathing Gastropods. The latter series begins with carnivorous forms, the worm-eating genus *Testacella*, in which the shell is degenerate, owing to its subterranean habits, standing first,[1] followed by the Floridian *Glandina*, which has a well-developed shell, and subsists largely upon snails, swallowing them whole and digesting the soft parts out of the shells at leisure. Following these are the Achatinas of Africa, largest of land snails. The striped, oval shells are 8 or 9 inches long. With them are specimens of their eggs, hitherto, I believe, undescribed. They are about the size of a sparrow's egg, oval, with calcareous shell, and of a bright sulphur-yellow color; the only case known to me of a land snail having colored eggs.

In an adjacent case are the South American Bulimi, *Tomigerus* and *Anostoma*, having upturned apertures. An Amazonian Indian who collected them said to Professor Ward, "God laughed when he made these shells"

The numerous families of marine gastropods are represented by characteristic specimens, among them a good number of species which, to my knowledge, are not in any other American museum. The families *Volutidæ*, *Conidæ*, and *Muricidæ* may be mentioned as affording valuable material. An example of *Xenophora conchyliophora* carried a load of rounded pebbles soldered to his shell instead of the usual disguise of shells and shell-fragments, obviously showing the character of the sea-bottom he lived upon, and an ability to adapt himself to unusual circumstances.

In the *Turbinidæ* we examined the unique type of *Astralium Wardii* Baker, and incline to consider it a form of *A. Japonicum* Dkr. It will be of interest to conchologists to learn that the hitherto unknown operculum of *A. modestum* Rve. of Japan is represented by several specimens, and that it proves to be of the same abnormal type as that of the Mediterranean species, *A. rugosum*, the form and the position of the nucleus being the same in both. The operculum of *A. modestum*, however, is pure white, while that of the other species is scarlet.

The series of Lamellibranchiata is of equally great extent. But further enumeration would be tedious. We may confidently state that those interested in science-education or in animal life-history and structure will find, as the writer has done, that this collection is full of most valuable suggestions and material, and will well repay a visit to Rochester.

[1] The writer has recently shown that the South African genus *Aerope* is more highly specialized than any other carnivorous land-snail, and it should, therefore be given first place in the series.

SCIENCE:

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NON-EUCLIDEAN GEOMETRY.

BY G. A. MILLER, PH.D., EUREKA COLLEGE, EUREKA, ILL.

EUCLID'S elementary geometry was written about three centuries before the Christian era. We must conclude that it was much superior to all preceding works on this subject. Proclus, who wrote a commentary on Euclid's Elements in the fifth century of our era, represents it such, and his statements are corroborated by the facts that all similar works of Euclid's predecessors have ceased to exist, and, if any elementary geometry was written by a Greek after Euclid, there is no mention made of this anywhere.[1]

The facts that Euclid's Elements are still used as a text-book — especially in England — and that the works used in its place are generally based upon it, are perhaps still stronger evidences of its excellence.

No geometry can be written without making some assumptions with respect to the space with which it deals. These are generally of such a nature as to commend themselves to our full confidence by their mere mention, and are commonly called axioms. It is the duty of the geometer to demonstrate properties and relations of magnitudes by non-contradictory statements which rest ultimately upon these axioms. It is evident that the axioms should be as few and as clear as possible. Upon essentially different axioms essentially different geometries may be established.

Among the axioms of Euclid there is at least one which is not axiomatic.[2] This is the axiom of parallels, which reads as follows: —

"If a straight line meet two straight lines so as to make the two interior angles on the same side of it taken together less than two right-angles, these straight lines, being continually produced, shall at length meet on that side on which are the angles which are less than two right-angles."

All the popular text-books on elementary geometry employ this axiom either in this form or in some shorter form, such as, "Through a point without a line only one line can be drawn parallel to the given line."

Many efforts have been made to demonstrate this axiom. Since it does not depend upon more elementary axioms, such attempts must be futile. If we assume it to be true, it follows directly that the sum of the three angles of a plane triangle is two right-angles; and, conversely, if we should assume that the sum of the internal angles of a plane triangle is two right-angles, this axiom would follow.[3]

As the geometers who do not adopt all the axioms of Euclid deny this, non-Euclidean geometry is sometimes defined as the geometry which does not assume that the sum of the three angles of a plane triangle is two right-angles. A more satisfactory definition is, non-Euclidean geometry is a geometry which assumes other properties of space in place of the following properties of Euclidean space: —

The sum of the three angles of a plane triangle is two right-angles, space is an infinite continuity of three dimensions, and rigid bodies may be moved in every way in space without change of form.

Just one hundred years ago (1792) the famous mathematician Gauss began the study of a geometry free from the first of these assumptions. He did not publish the results of his study. We may infer something in regard to them from his letters.[4] It was not until 1840 that a geometry was published in which Euclid's axiom of parallels was replaced by another, and the sum of the angles of a plane finite triangle was thus shown to be less than two right-angles. The work was written by a Russian mathematician named Lobatschewsky. It contains only sixty-one pages and bears the title "Geometrische Untersuchungen zur Theorie der Parallellinien." He began his treatment of parallels by observations, in substance, as follows: —

Given a fixed line (L) and a fixed point (A) not on this line. The lines through A lying in the plane determined by A and L may be divided with respect to L into two classes — (1) those intersecting L, and (2) those not intersecting L. The assumption that the second class consists of the single line which is at right-angles with the perpendicular from A to L is the foundation of a great part of the ordinary geometry and plane trigonometry. While the assumption that the second class consists of more than one line leads to a newer geometry, whose results are also free from contradictions.[5] This newer geometry was called non-Euclidean geometry by Gauss, imaginary geometry by Lobatschewsky, and absolute geometry by Johann Bolyai.[6]

It is certainly of interest to learn what some of the foremost mathematicians have said with respect to this geometry. Professor Sylvester said in regard to Lobatschewsky's work: —

"In quaternions the example has been given of algebra released from the yoke of the commutative principle of multiplication — an emancipation somewhat akin to Lobatschewsky's of geometry from Euclid's noted empirical axiom."

Professor Cayley said: —

"It is well known that Euclid's twelfth axiom, even in Playfair's form of it, has been considered as needing demonstration; and that Lobatschewsky constructed a perfectly consistent theory wherein this axiom was not assumed to hold good, or, say, a system of non-Euclidean plane geometry."

Another very eminent mathematician, Professor Clifford, in speaking about the same work, said: —

"What Vesalius was to Galen, what Copernicus was to Ptolemy, that was Lobatschewsky to Euclid."

Something of the nature of this geometry may be inferred from a few of its theorems which differ from the corresponding theorems of the ordinary geometry. In addition to the important theorem that the sum of the internal angles of a plane finite triangle is less than two right-angles, it is proved that if we have given a line (L) and a perpendicular (B) to L, the parallels to L through points on B will make angles with B varying from $\frac{\pi}{2}$ to 0; so that we can draw through B a parallel to L making any given angle with B.[7]

The locus of a point at a constant distance from a straight line is a curved line.[8]

The areas of two plane triangles are to each other in the ratio of the excesses of two right-angles over the sums of their angles.[9]

We proceed now to some observations on the second property of Euclidean space mentioned above, viz., that space is an infinite continuity of three dimensions. We shall not take up the question of the infinitude of space nor Riemann's distinction between

[1] Cantor's Vorlesungen über Geschichte der Mathematik, Vol. I., p. 224.

[2] Encyclopædia Britannica, Vol. VIII., p. 657.

[3] Frischauf's Absolute Geometrie, pp. 14, 15.

[4] Briefwechsel zwischen Gauss und Schumacher,— especially Vol. II., pp. 268–271.

[5] Lobatschewsky's Theorie der Parallellinien, Art. 22.

[6] Frischauf's Absolute Geometrie, Art. 13.

[7] Lobatschewsky's Theorie der Parallellinien, Art. 23.

[8] Frischauf's Absolute Ge. metrie, p. 18.

[9] Frischauf's Absolute Geometrie, p. 50.

infinite and undounded as applied to space, we shall content our selves with a few remarks on the number of dimensions of space.

In ordinary geometry we say that the limit or boundary of a solid is a surface, the limit of a surface is a line, the limit of a line is a point, while the point is indivisible. The same thought is expressed in other words when we say a solid has three dimensions, a surface two, a line one, while a point has no dimensions. Although the question of three dimensions of space has engaged the attention of many philosophers, no one has succeeded, to the present, to give a deep reason which is not based upon our experiences why after three passages over the limits (beginning with a solid) we should arrive at the indivisible.[1] Our inability to conceive solids or figures of more than three dimensions does not disprove their existence. If we imagine a world of two dimensions, in which all things consist of two dimensional figures, in which the inhabitants are so constituted that they can receive impressions only from things in the surface which constitutes their universe, and if we consider how unthinkable to such beings might appear figures of three dimensions, we may perhaps be prepared to admit the possibility of a space of more than three dimensions.[2]

The relations of algebra and geometry are such that an equation involving n unknowns ($n \gtrless 3$) finds its geometric interpretation in a space whose dimensions are equal to the number of unknowns in the equation. The dual (algebraic and geometric) solution of algebraic equations enhances greatly their value and interest. Algebra does not restrict itself to a fixed number of unknowns. The question whether there is a corresponding practical geometry of a space whose dimensions are not fixed is of the greatest interest. We shall designate such a space by E_n, $(0 \gtrless n \gtrless \infty)$, hence E_n contains all the points of this space.

In constructing a geometry for E_n it is necessary to select a set of axioms. These axioms must be so chosen that when E_n becomes an E_a $(0 \gtrless a \gtrless 3)$ this geometry will lead to results harmonizing with our experiences. We proceed to give a few of the assumptions from an approved work on n-dimensional space.[3]

Through each point pass many E_{n-1} having the following properties: —

Through point of an E_{n-1} pass many E_{n-2} on which the E_n may be moved; by this motion the E_{n-1} may be made to occupy completely its first position, while the individual points have changed their positions.

In each E_{n-2} there are many E_{n-3} on which the E_{n-1} may be rotated in itself. By this rotation each point will describe a closed curve.

Starting with such assumptions, a geometry is constructed by collecting and classifying theorems which rest ultimately upon them. It is perhaps worthy of remark that attempts have been made to prove the impossibility of a fourth dimension.[4]

As the main object of this article is the presentation of the non-Euclidean geometry of two dimensions, we proceed to develop the foundations on which rests a still more general two-dimensional geometry than the one noted in the fore-part of this paper. The understanding of the following processes will demand some mathematical attainments beyond what is required to appreciate the preceding. The formula which we desire to use is given in Killing's Nicht-Euklidische Raumformen, p. 14. We shall here give a simple outline of its development, referring the reader to that work for the rigorous proofs of some of our statements. We give here two almost axiomatic theorems which we shall need later.

To a triangle whose sides are all infinitesimals all the principles of the ordinary geometry and plane trigonometry apply, independent of the axiom of parallels. If one angle of a triangle becomes an infinitesimal while the others remain finite, the ratio of the sides including the infinitesimal angle has unity for its limit.

Given a triangle with a constant finite side (c) and a constant adjacent angle β, while the other adjacent angle (α) is infinitesimal. The side (a) opposite α must also be infinitesimal. The lines which divide this α into n equal parts also divide a into n equal parts. Hence the ratio $\frac{a}{\alpha}$ depends not upon α (α remaining infinitesimal) but upon c and β. The limit of this ratio when $\beta = \frac{\pi}{2}$ and α is in the act of vanishing is denoted by $f(c)$. For any other value of β this limit is $\frac{f(c)}{\sin\beta}$. Let c increase by an infinitesimal h, and $\frac{a'}{\alpha} = \frac{f(c+h)}{\sin\beta}$. Since $\frac{\sin\beta}{\alpha} \times \frac{a'-a}{h}$ has a finite limit when h is in the act of vanishing, its equal, $f'(c)$, must have the same limit. We may suppose a triangle formed by keeping β and c constant while α increases to a finite angle. We thus obtain a triangle in which a, β, α, c are finite. We will call the third side and the third angle b and γ, respectively. In this triangle we may let α undergo an infinitesimal increase, $d\alpha$, at the same time a, b, γ will increase by da, db, $d\gamma$, respectively. This increase of the triangle is a triangle like the one just considered, and the formulas obtained are directly applicable to it. The following formulas can easily be proved: —

$$(1) \qquad \frac{da}{d\alpha} = \frac{f(b)}{\sin\gamma}, \quad \frac{d\gamma}{d\alpha} = -f'(b), \quad \frac{db}{da} = \cos\gamma.$$

The first has been found in the preceding triangle. From it we also obtain —

$$\frac{\sin(\pi-\gamma)}{d\alpha} \times \frac{a'-a}{h} = f'(b);$$

but
$$\frac{a'-a}{h} = \frac{\sin[\pi-(\pi-\gamma+\gamma+d\gamma)]}{\sin\gamma},$$

hence the second equation. The third follows directly after drawing perpendicular from γ upon the side $b+db$.

From equations (1) we obtain easily —

$$\frac{f'(b)\,db}{f(b)} = -\frac{\cos\gamma\,d\gamma}{\sin\gamma}.$$

Intergrating this—

$$\log f(b) = -\log\sin\gamma + \log C.$$

When $\alpha = 0$, it follows that $b = c$, $\gamma = \pi - \beta$. From this we find $\log C$, and the equation takes the form

$$f(b)\sin\gamma = f(c)\sin\beta.$$

Differentiating, α and c being regarded constant, we obtain

$$f'(b)\sin\gamma\,db + f(b)\cos\gamma\,d\gamma = f(c)\cos\beta\,d\beta.$$

Substituting from (1), remembering that β, b takes the places of α, a, there results

$$f(a)f'(b) - f'(b)f(a)\cos\gamma = f(c)\cos\beta.$$

Hence, cyclically,

$$f(a)f'(c) - f'(c)f(a)\cos\beta = f(b)\cos\gamma.$$

Multiplying the last by $f'(a)$ and subtracting from the preceding there results,

$$f(a)[f'(b) - f'(a)f'(c)] = f(c)[1 - \{f'(a)\}^2]\cos\beta.$$

Combining with this the analogous equation

$$f(c)[f'(b) - f'(a)f'(c)] = f(a)[1 - \{f'(c)\}^2]\cos\beta.$$

By division,

$$\frac{\{f(a)\}^2}{1-\{f'(a)\}^2} = \frac{\{f(c)\}^2}{1-\{f'(c)\}^2}.$$

Since a and c are independent, the members of this equation must be constant. Hence the important equation —

$$\frac{\{f(c)\}^2}{1-\{f'(c)\}^2} = k^2$$

[1] Killing's Nicht-Euklidischen Raumformen, p. 64.

[2] A short romance, entitled "Flatland," depicts the difficulty an inhabitant of a two-dimension world (a square) had to conceive of three-dimensional space, even after he had acquired some idea of a one-dimension, or line, world. The book is published by Roberts Brothers, Boston, Mass.

[3] Killing's Nicht-Euklidischen Raumformen, p. 65.

[4] Max Simon, Zu den Grundlagen der nicht-euklidischen Geometrie, p. 26.

In which k is some constant. Substituting from (1) we obtain

$$\frac{1}{k^2} = \frac{da^2 - d\gamma^2}{da^2 \sin \gamma}.$$

By making $\frac{1}{k^2} = 0$, we obtain $da = d\gamma$, which, from the triangle in which these occur, is equivalent to saying, the sum of the angles of a plane triangle is constant and equal to two right-angles. This hypothesis leads to the Euclidean, or parabolic, geometry, making $\frac{1}{k^2} < 0$ makes $d\gamma > da$, which shows that the sum of the angles of a plane triangle is less than two right-angles, and leads to Lobatschewsky, or hyperbolic, geometry. Finally, the hypothesis $\frac{1}{k^2} > 0$ makes $da > d\gamma$ and indicates that the sum of the angles of a plane triangle is greater than two right-angles. This gives rise to the elliptic geometry. The last is divided into two divisions — the single elliptic geometry and the double elliptic geometry. The names parabolic, hyperbolic, single elliptic, and double elliptic were applied to these spaces by Klein. The last two kinds of space are nearly alike. Euclidean geometry may be regarded as the common limit of the hyperbolic and the elliptic geometry. Considerations similar to the preceding lead to four kinds of n-dimensional space, and hence there are four kinds of n-dimentional geometry.

ALTAKAPAS COUNTRY.

BY JOHN GIFFORD, SWATHMORE COLLEGE, PA.

IN the southern part of Louisiana there is an interesting region called the "Altakapas Country" It was once inhabited by a tribe of Indians of that name. They have the reputation of having been cannibals, but the later generations were peaceful and industrious. A few of them, they say, still exist and are famous for the skilful manner in which they make a peculiar kind of basket-work. Specimens of this may be seen in the museum of the Tulane University of Louisiana.

Roughly speaking, the region referred to embraces the land bordering the Gulf, west of the Atchafalaya and east of the Mermentau River. There is some discussion as to the extent of the country known by that name. As ordinarily used the term is elastic, but in a map printed in 1826 it includes all of what was then known as La Fayette, St. Mary's, and St. Martin's parishes and what is now known as Vermillion, La Fayette, St. Martin's, and St. Mary's.

Excepting five islands to which I shall refer later, this country is low, level, and rich. It is a part of the alluvium of the delta, which is intersected by many bayous, the arteries of Louisiana. The Atchafalaya is sometimes called "Old River," and was once no doubt the bed of the Mississippi. To-day it is reddened by the water from the Red River, in the mouth of which it begins. It is now perhaps the largest collateral artery of the main trunk. It was once clogged by an enormous raft, which was removed by the State in 1835. According to LeConte, it "was a mass of timber eight miles long, seven hundred feet wide, and eight feet thick. It had been accumulating for more than fifty years, and at the time of its removal was covered with vegetation, and even with trees sixty feet high."

The Altakapas country consists of tilled lands, low meadows, and sea-marshes. The thriftiest of the first extends along that tortuous, sluggish stream called Bayou Teche. It is very rich and well cultivated, and by many is considered the garden-spot of the State. The banks of the Teche are lined by beautiful sugar plantations with old-time palatial residences and many modern refineries. Cane is there worked, and sugar and molasses manufactured according to the latest scientific methods. Enormous quantities of sugar, molasses, rice, cotton fibre, oil, and meal, and cypress lumber are shipped from this region. Even the moss on the trees is the source of an income of no little consequence.

This bayou begins in a network of streams in the Red River country and empties into the Atchafalaya below Grand Lake. In few places in the world will you meet with such scenery. A trip down the Teche from St. Martinsville, a quaint town grey with age and "finished" long ago, once called "the little Paris, the land of Evangeline," on a sugar-packet is claimed by many, for scenery of its kind, to be unrivalled outside of Louisiana.

West of the Teche are miles of meadow-land, where many herds of horses and cattle pasture. Southward bordering the bays and Gulf is a region of sea-marshes and floating prairies.

In the midst of this marsh, near Vermilion and Atchafalaya Bays, there is a chain of five islands, the highest land in lower Louisiana. The most western is called sometimes Miller's, sometimes Orange, and sometimes Jefferson's Island. It is the centre of Joseph Jefferson's famous plantation. The second is called Petite Anse or Avery's Island, where the Avery salt mine is located, the like of which, they say, does not exist in this country. The third is Week's Island, the fourth Cote Blanche, and the last Belle Isle.

The fact that five islands exist, much different from the surrounding country, of a different formation, in a straight line, about six miles apart, in the Mississippi Delta is curious. But stranger still the core of Avery's Island is a mass of rock salt of the purest kind, the only impurity, in fact, is .120 per cent of gypsum.

While prospecting for the opening of another mine, they found the bones of the mastodon, giant sloth and perhaps of other extinct animals in layers of material of a peaty nature. Here, also, were found beautiful potsherds and kitchen middens of the Indians who once lived there There were also indications, I was told, that the Indians knew of the presence of this salt, although, according to Dr. Hilgard, it was not discovered by the whites until 1862. The bones and potsherds which were found there are now in the museum of the Tulane University of Louisiana.

To scientists and sightseers these mines are well worthy a visit, but unfortunately are rather inaccessible. It is easiest reached from New Iberia on the Southern Pacific Railroad There is a freight train running to the mines, which carries a passenger car. This remains, however, only long enough to collect the freight, which is seldom more than thirty minutes. There is only one train daily. The wagon-road is dangerous at times and never pleasant for vehicles owing to much mud, bad bridges and a pole-road over the marshes. The best way to reach it is on horseback, and for this purpose the Acadian ponies have no equal. They have a peculiar gait, faster than a fast walk, and lift their feet in a quick peculiar manner, which comes, they say, from pulling their feet quickly out of miry places.

The island is visible a long way off, and owing to the contrast with the surrounding country is very striking and prominent. The soil is pure sand and clay, in places mixed to form a loam.

To enter the mine you are apparently instantly dropped down a shaft one hundred and seventy feet deep. You are then in a huge cake of salt resembling ice. The weight above is supported by huge pillars of salt. Enormous quantities have been removed and the supply seems exhaustless. In places it is as clear and transparent as ice, in others granular, in others dark in color, and in others in irregular waves as though contorted by pressure. Here and there are pockets in which beautiful cubical crystals may be found, some of which the writer collected were $1\frac{1}{4} \times 1\frac{1}{4} \times 1$ inches in size.

Although it affords ventilation, they have been troubled by a slight cave, which of course gradually washes larger in size, and a fine sand is thus washed into the mines.

In the Smithsonian Contributions, Vol. XXIII., Dr. Eugene Hilgard has described this formation in a paper entitled "Geology in Lower Louisiana and the Salt Deposit of Petite Anse Island."

One of the other islands borders on the bay, where there is a bluff from which the formation may be studied.

Over in the neighboring parish of Calcasieu, near Lake Charles, there is a bed of sulphur which promises to become an important industry.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Nervous Diseases and Civilization.

IN Dr. Brinton's note on "Nervous Diseases in Low Races and Stages of Culture" in your issue of Dec. 16, he holds that those are in error who claim that "diseases of the nervous system have greatly increased with the development of civilization." My own very positive conviction, based upon a somewhat extended experience in the treatment of neurasthenic cases, is quite the reverse of this. In hospitals, in dispensaries, and among the very poor everywhere, a typical case of neurasthenia is difficult to find, but among the well-to-do and the intellectual, and especially among those in the professions and in the higher walks of business life who are in deadly earnest in the race for place and power, this peculiar impoverishment of nerve force that we term "neurasthenia" appears with alarming frequency.

Dr. Brinton says also that "civilization, so far from increasing this class of maladies, is one of the most efficient agents in reducing them in number and severity, especially when freed from religious excitement and competitive anxieties."

It should, however, be remembered that these "competitive anxieties," this worry of business and professional life, are the very conditions that civilization fosters and intensifies, and therefore civilization itself, with all that the term implies, with its railway, telegraph, telephone, and periodical press, exciting in ten thousand ways cerebral activity and worry, is the primary cause of this increase of nervousness among the higher classes in all countries. American nervousness is becoming almost a distinctive phrase, and it cannot be denied that in this country there are climatic conditions, and business and social environments, to the influence of which the nervous system is peculiarly susceptible, especially if complicated with evil habits, excesses, tobacco, alcohol, worry, and special excitements. In the older countries men plod along in the footsteps of their fathers, generation after generation, with little possibility, and therefore little thought, of entering a higher social grade. Here, on the contrary, no one is content to rest, with the possibility ever before him of stepping higher, and the race of life is all haste and unrest.

It has been aptly said that "the human body is a reservoir of force constantly escaping, constantly being renewed from the one centre of force — the sun." A perfectly healthy man has a large amount of nerve force in reserve, and this reserve is not often exhausted, even approximately, by the necessary toil and wear of mind and muscle. A nervously exhausted man has a small amount of nerve force in reserve, and this reserve is often and speedily exhausted.

The margin on which he can draw is narrow, may be almost wiped out under the calls of emotion and of mental and bodily labor, but, just as with the strong man, the force is renewed from without by food and repose, so, like the strong man, he can keep on thinking and worrying until he dies, which may be long after the death of the strong man. While nervousness makes life painful and irritating, it does not of necessity shorten life, nor does it always destroy its usefulness. "The Indian squaw, sitting in front of her wigwam, keeps almost all of her force in reserve. The slow and easy drudgery of the savage domestic life in the open air, unblessed and uncursed by the exhausting sentiment of love, without reading or writing or calculating, without past or future, and only a dull present, never calls for the full quota of available nerve force; the larger part is always lying on its arms. The sensitive white woman — pre-eminently the American woman — with small inherited endowment of force; living indoors; torn and crossed by happy or unhappy love; subsisting on fiction, journals, receptions; waylaid at all hours by the cruelest of all robbers, worry and ambition, that seize the last unit of her force, can never hold a powerful reserve, but must live, and does live, in a physical sense, from hand to mouth, giving out quite as fast as she takes in,— much faster oftentimes,— and needing longer periods of rest before and after any important campaign, and yet living as long as her Indian sister,— much longer it may be,— bearing age far better, and carrying the affections and the feelings of youth into the decline of life" (Beard's "Sexual Neurasthenia," edited by A. D. Rockwell, M.D., E. B. Treat, New York publisher).

While Americans are undoubtedly a particularly nervous people, it is well to remember that a large number who think themselves nervously exhausted altogether misconceive their real condition. There is a vanity of disease as well as of dress. Many would rather be thought nervous than bilious or gouty, and are pleased with a diagnosis which touches the nerves rather than the stomach, bowels, or liver. As a matter of fact, the nervous system in many of these cases is strong enough, and would give no trouble were it not poisoned by the abnormal products of digestion that enter the blood and circulate freely through every tissue of the body, and the practical and all-important point is, to differentiate between these two classes. The array of symptoms in each class of cases is so much alike that real impoverishment of nerve force due to overwork and worry is often confounded with a poisoned condition of the system, the result of indolent habits and an excess of food; and, instead of rest, quiet, and soothing draughts, there is need of mental and physical activity,— less not more food, depletion rather than repletion.

New York. A. D. ROCKWELL, M.D.

Observations on the Cretaceous at Gay Head.

SINCE my good friend Mr. David White has thought it worth while to give me a gentle reminder that I have been "a little confident and hasty in naming the various terranes at Gay Head," it seems becoming and necessary that I should offer a few short remarks in elucidation of my statements published in these columns Sept. 23, 1892, and somewhat more fully in the Transactions of the Maryland Academy of Sciences, 1892, pp. 204–212. The points of difference between Mr. White and myself are not so great as to cause questions of moment to arise from their statement. It seems evident to me that if we could visit Gay Head together for only a few hours he would not be able to resist the evidence of observation which results from clearing away the covering of the face of the bluffs. My statements were derived from an examination of the body of the hill behind the loose, or thrown, material spread upon its faces. In order to get at the beds *in place*, and which really constitute the promontory of Gay Head, it was necessary to dig away a few feet, or inches, of sand, clay, marl, and other slipped material from many parts of the face of the bluffs. This I did with the assistance of men from the neighborhood, and by this means it became possible for me to see that the axis of the whole system was a lead-colored clay, and that upon this eroded ridge of clay, which descends below lowest tide-level, all the other geological members rest in their usual nearly horizontal order of sequence, as in Maryland and New Jersey. Since my return home, I have compared this clay more thoroughly with samples from the Woodbridge and Amboy districts of New Jersey, and the conviction is pressed upon me that the two are identical, as far as regards elements and type of structure. Nevertheless, as I have not found fossils in this clay, it is not possible for me to decide as to its exact horizon. From its relative position in the column of strata, it should belong near the middle of the Albirupean formation, and therefore it should be a homologue of the dark member of the clay which occurs in the upper middle portion of the terranes at both Amboy and Woodbridge. The fact should not be forgotten that there are three distinct types of "Variegated Clay," and that these three belong to levels wide apart, and in three different formations, viz., the Potomac, the Albirupean, and the Raritan. All these become variegated by disturbance and saturation with iron-bearing waters, while in their unchanged condition they are either lead-colored or drab. The use of the term "Potomac" in the papers above cited was in deference to the usage of Messrs. McGee and Darton, but with the accumulated evidence now present to my mind it does not seem likely that the axial clay of Gay Head and Martha's Vineyard can be referred to the "Variegated Clay" of the Potomac formation as designated by Professor Fontaine and myself.

With regard to the Miocene fossils, especially the Cetacean vertebræ, settled into the broken surface of the Greensand, I did not enter into detail as to a wider distribution of these remains. It was not necessary for me to open out another series of observations beyond my immediate purpose. Let it suffice to say, however, that these remains are not confined to the surface of the Greensand, but that other specimens of the same were found by my own efforts at various points beyond this section of the bluffs.

I cannot admit that "each season presents new phases and unsettled local stratigraphic complications" in more than a superficial sense. The body of the promontory is not broken up, although every storm does abstract from or disturb a part of its face. Photographs in my possession show various changes which have been made from time to time in the ends and sides of the beds there exposed, but not a dislocation of the main body of the ridge. They confirm also the observation that several buttresses of the "Raritan" resting upon the lead-colored clay extend outward in original order from the ridge, while the intervening ones flanking the gullies are built of overthrown strata.

The so-called faulting is of a type common to clayey and sandy terranes, such as we are familiar with in the tide-water region of Maryland, where atmospheric agents, especially frost and thawing, open cracks somewhat parallel to the brow of a bluff. These cracks gape wider and extend deeper as the power of the sun increases, and at length cause a down-slide or fall when the beds become weakened by saturation with rain-water. Such fissures are also opened more widely and deeply by the dropping into them of coarse sand and pebbles, which spread apart by freezing and thawing. A notable example of this kind occurred to my observation on the projection of a heavy body of massive granite on Jones's branch, near Baltimore, where a fissure caused by freezing and thawing was gradually opened by an influx of sand, but which burst apart with almost explosive force one afternoon in the spring, following a season when numerous quartz pebbles had fallen into the crack from the overlying soil. The same phenomenon may be seen in the broken masses of granite which occur in places along the shores of Fisher's Island, near New London, Conn.

Several years ago, when many of the trees had been cleared from the brow of the cliffs of Potomac clay, along the shores of the Patapsco River, fissuring took place at intervals near the borders of these hills, and downthrows from the front of the bluffs were of common occurrence. In connection with such movements, and especially following a season of heavy autumnal rains, large cavities were rent in the cracking clays, some of which were large enough to admit a moderately large boy.

An example of the Gay-Head type of slipping, crushing, and swelling out, on a somewhat smaller scale, may be seen adjoining Sullivan's Cove, at the north-western end of Round Bay, Severn River, Md., and several of the same features, on a grand scale, may be studied next the face of Maulden's ridge, on the North-east River, Md.

The type of cutting and downthrow of the bluffs on the Vineyard Sound side of Gay Head is far more complex and varied than that of the south-west, or Atlantic, side. On the former the diagonal stroke of a surf from the south-east would cut deeper than the straight forward blow of the Atlantic on the south shore, and accordingly would be more effective in undermining the face of the terrane. The effects of those two methods of erosion are well shown on the opposite sides of this coast.

With regard to the aggregation of the non-marine lower portion of this series of formations, it seems probable that they were begun in the rocky hollows along the whole Atlantic coast from Maine to Cape Hatteras; that rapid currents carried large accumulations of broken stone and the elements of the crystalline rocks many miles out into a shallow sea, which was later barred out by the thick accumulations of these deposits, that thus a series of almost closed sounds was connected with the border of the continent, and that these sounds, extending in a sinuous north-east line, were the places of deposition of all the beds and strata which we now recognize as the Potomac, Albirupean, and the Raritan formations.

It has been my pleasure to read carefully both of Professor Shaler's accounts of Gay Head, and to recognize the many good statements that he has made regarding particular features of the region; but I fail to see that he has given an adequate account of the real structure of the promontory, of its relations to other parts of the island, or of its relations to the similar deposits in Massachusetts, Rhode Island, and Long Island. P. R. UHLER.

Baltimore, Md., Dec. 19.

The Reticulated Structure of Protoplasm.

AFTER I had read the proof of the article on the reticulated structure of human red blood-corpuscles published in *Science* for Sept. 16, 1892, I received a book recently issued in Paris, and entitled "La Cellule Animale, sa Structure et sa Vie, Étude Biologique et Practique, par Joannes Chatin, Professeur adjoint à la Faculté des Sciences de Paris, Chargé du Cours d'Histologie à la Sorbonne, Membre de l'Académie de Médicine." In this delightful treatise, which brings the knowledge of the animal cell to the present time, there are one or two statements in regard to the structure of protoplasm which I should have liked to quote in the paper mentioned, but as that is now impossible, I have asked the editor kindly to allow me to call attention to the following: —

C'est seulement en 1880, à la suite des recherches de Heitzmann, de Fromann et surtout des publications de Hanstein, que l'on commence à modifier la conception générale du protoplasma, pour le considerer, non plus comme une masse indifférente, mais comme une substance structurée.

Cette interprétation recontra une assez vive opposition. Il est des esprits scientifiques qui tiennent à demeurer constamment fidèles aux principes dont ils se sont inspirés dès leurs premières études et qu'ils ne consentent que difficilement à abandonner. . . .

On doit distinguer dans le protoplasma deux parties: l'*hyaloplasma* et le *paraplasma* (Fig. 49).

L'hyaloplasma est une substance fibrillaire, hyaline, réfringente, formant un réseau au milieu d'une substance fluide, moins réfringente, qui est le paraplasma. Qu'on se représente une éponge a travées très tenues et contractiles, plongée dans une substance visqueuse et granulée qui remplirait ses cavités. Cette comparaison donne une idée grossière, mais assez exacte, de la masse protoplasmique prise dans son ensemble.

Elle paraît homogène si les mailles de l'hyaloplasma sont uniformes et qu'on fasse usage d'un faible grossissement. C'est ainsi que le protoplasma avait été étudié durant longtemps, et l'on s'explique d'autant mieux l'erreur dans laquelle on demeurait à l'égard de ses parties constitutives, qu'elles ne se distinguent en général qu'après l'intervention de certains réactifs comme l'acide osmique. Cependent l'histologie zoölogique permet de les observer directement, et j'ai deja eu l'occasion de mentionner à cet égard l'exemple des cellules glandulaires de la Testacelle.

La structure réticulée du protoplasma s'observe dans les cellules amiboïdes comme dans les éléments à forme définie; l'étude des globules sanguins des Invertébrés (Vers, Crustacés, etc.), permet de constater aisément ce fait, d'abord révoqué en doute par des observateurs qui limitaient leurs recherches aux éléments de quelquels animaux supérieurs. ALFRED C. STOKES.

Trenton, New Jersey.

Auroral Displays.

IN answer to Professor Swift's inquiry in *Science* of Dec. 9, I will say that I saw "that memorable spectacle" in the winter of 1834 or 5 when "the snow and the sky suddenly assumed," in the evening, "a bright crimson red." It is one of the most distinct things in my remembrance. I was then well along in my "teens," but had not then undertaken very extensive meteorologic observations and records.

When Dr. Swift speaks of the aurora of July 16 last as "the grandest auroral display of the century," does he take into account the great aurora of August, perhaps, in 1859, when the whole sky was covered with beautifully colored streamers? A fine corona appeared, the display lasted from evening until morning twilight, was repeated less brilliantly during the following night, and with intermediate disturbances of the telegraph lines and of the mag-

netic instruments through the day. This great magnetic storm exhibited, if I am not mistaken, its phenomena in the southern, in the northern, in the eastern, as well as in the western, hemispheres. I watched the display for most of the two nights at West Springfield, Mass., and read many notices of it in the public prints.

I will add that at 10.45 P.M., Dec. 5. 1892. I saw, to me, an unique phenomenon. The moon was shining brightly, when diverging bands from the horizon in the north-north-west spread at the zenith 60° wide and converged again at the horizon in the south-south-east. They were like thin clouds, through which the stars were easily seen. The belt of Orion was exactly then in their midst. I can liken their shapes to nothing more than the vibrations of a cord, stretched from horizon, over the zenith, to horizon again. But they were stationary, and had so far disappeared at 11.30 P.M., standard time, that only curious traces and patches remained. I fancy that had not the moon been shining, these beautiful bands would have shown luminosity.

I judged that the radiating point in the north north-west was a trifle west of the magnetic meridian there; but our western declination here is some nine degrees. These were, of course, parallel bands, the divergence and convergence points being the effect of perspective. JAMES HYATT.

Honeymeadbrook Station, N.Y., Dec. 19.

Alleged Extinction of Mulatto.

A FEW months since an article appeared in a medical journal affirming that the *pure mulatto* colonies of southern Ohio were dying out after the fourth generation. Can any reader point me to the article in question, or to any *definite* information bearing on the permanence of the mulatto as a species (or variety)?

Polytechnic Society, Louisville, Ky. JAS. LEWIS HOWE.

BOOK-REVIEWS.

Lessons in Elementary Mechanics. By SIR PHILIP MAGNUS. New York, Longmans, Green. & Co., 1892. 370 p. 12°.

Elementary Manual of Applied Mechanics. By ANDREW JAMIESON. London, Griffin & Co. 265 p. 12°. $1.25.

THESE two little treatises on mechanics illustrate two very distinct lines of college and school work, and are each characteristic of its class. Sir Philip Magnus has been distinguished for many years for his success as an author in this field, and his "lessons" have gone to their thirtieth thousand. The method of treatment of the subject is that which has been endorsed by authority and become "standard." The usual division of the subject into kinematics and dynamics is observed; and the latter is again subdivided, as customary, into kinetics and statics. Motion, as a more elementary idea than force, is first discussed, then follows the study of force and its effects in the production of equilibrium. The study of kinetics and of statics brings out the differences in effect when the body is free to move and when the forces produce no motion. The special feature of the book is the admirable manner in which energy is discussed and its operation illustrated. The extent of the work is such as is expected to suit the wants of the scholar of the first year, and is well adapted to the needs of those proposing to take the London University course or other of similar character. For this country it will make an excellent high-school course.

Professor Jamieson's work is characterized by its constant utilization of the principles taught, by application in the problems of every-day life and of constructive work. Even its illustrations have the advantage of being selected from among those of builders of machinery illustrating the principles treated. It is intended to meet the needs of students preparing for science and art examinations; but should be found of special value to those proposing to enter upon a course of technical education. It would be an admirable work for the better class of manual training schools, from which students pass into the technical colleges and professional schools of engineering. This establishment of a close relation between the principles taught and their useful applications in industry, and in the design and construction of machines, is a matter in which the older text-books have utterly failed, but in which the author uniting a knowledge of principles with familiarity with practice may always succeed, and with great advantage to himself in competition with the teachers of the abstractions alone. Even the average practitioner would be none the worse for a careful review of this little primer of mechanics.

The best of books have their little defects; and we observe, in both these primers of mechanics, the old, and long-ago exploded, ideas on friction; no distinction being made between the laws of solid and those of fluid friction and the "mediate" friction of lubricated surfaces. Here are the old laws and the actual fact in "parallel column": —

Laws of Friction.

Solid (Jamieson and others).	Fluid.	Mediate.
(1) F varies as Pressure.	F is constant with P varying.	F varies as $f(P)$.
(2) F independent of Areas.	F varies as A.	F varies as $f(A)$.
(3) F independent of Velocity.	F varies as V^2.	F varies as $f(V)$.

The first of these sets of "laws" is that usually found unqualified in elementary text-books and is, obviously, entirely misleading; although defective lubrication is so common in machinery that the result is less serious than might otherwise be the fact.

Geodesy (Riverside Science Series). By J. HOWARD GORE. Boston, Houghton, Mifflin & Co. 218 p. 16°. $1.25.

Introduction to Geodetic Surveying. By MANSFIELD MERRIMAN. New York, J Wiley & Sons. 170p. 8°.

THE first of these books is an historical account of the science of geodesy from the time of the ancients to the present, written in popular and interesting style, and is likely to prove most acceptable to the average reader, not an expert, who may desire to know something of the methods which have been adopted in the determination of the dimensions of the earth and their results. Its author has enjoyed the rare privilege of working from the original documents, as he states in his preface, and his sketch thus comes as authoritative. He commences his task by reference to, and brief descriptions of, the primitive notions of the older peoples, and their rude attempts to measure the earth. When their comparative ignorance of the subject, and their lack of instruments of exact measurement are considered, their approximations to the actual value of these dimensions seem little less than marvellous. The Chaldeans not only knew the earth to be "round" but made the degree equal to 4,000 steps of a camel, and the circumference of the earth about 24,000 miles. The Greeks and Romans took this quantity to be 250,000 stadia; the Arabians found it to be between 56 and 57 miles, 71 of our miles, per degree. Fernel, a French geometer of about 1550, measured the degree, and made it about 69 miles. Snell, in 1615, made the first scientific measurement of importance, however, making the arc of a meridian 55,072 toises, which is about 2,000 toises short. The toise is 6.4 feet.

Picard, in 1670, made the degree 57,060 toises, and so nearly correctly as to give to Newton his famous proof of the extension of the gravitation of the earth to its satellite. Later work is familiar to all interested in the subject, and it is a pleasure to note that the U. S. Coast Survey has done its share. It is considered by Professor Gore that the computations of Professor Harkness, making the ellipticity of the earth 1:300.2, and the quadrant to measure 10,001,816 meters, will prove most exact, although those of Bessel and Clarke are now generally received.

Professor Merriman's work is a formal and scientific treatise on the work of geodetic surveying. It includes a number of lectures on the figure of the earth, prepared as introductory, and also a discussion of the "Method of Least Squares," written especially for surveyors and engineers, as well as for students. The third and concluding part contains a synopsis of the methods and computations of precise triangulation. The introductory portion gives a history of the development of modern methods and some interesting facts relative to the work of the older geometers and

surveyors. The treatise is a most satisfactory one for its purpose; its author is known as not only an authority and in all respects competent, but as one of the most accurate and painstaking of writers. His work will undoubtedly find its place promptly, and will be adapted for purposes of instruction in many schools of the higher class, and will supply multitudes of young engineers with the facts and methods that they require in their practice.

Coals and Cokes in West Virginia: a handbook on the coals and cokes of the Great Kanawha, New River, Flat Top and adjacent districts in West Virginia. By WM. SEYMOUR EDWARDS. Cincinnati, R. Clarke & Co. 162 p.

MR. SEYMOUR has collected in this book a great mass of statistical and geological information which cannot fail to be useful and valuable to all who are interested in the West Virginia coal-fields. In the first chapter a brief review is given of the coal-measures as they occur in the southern part of the State, and this is followed by chapters giving details of numerous sections. We have first tables of vertical sections giving the name used by the Pennsylvania Survey, the local name, height or thickness, material, etc.; then tables of chemical analyses, tables showing comparative gas-yielding power, steam-producing power, and chemical analyses and physical tests of coke. This closes part one.

In part two we have sketches of various districts and tables showing the output, cost of production, transportation, and average prices obtained in a series of years. In these days of pools and combines by railroads, and of trusts by manufacturers, it is of interest to note the immense difference in cost of transportation when water and land carriage is considered. The Great Kanawha River has been improved under the auspices of the general government by means of locks and dams so as to afford continuous transportation facilities for about ten months out of the year. The most of the dams in the river are "movable," that is, can be lowered to the bottom of the stream in high water and raised when the river falls, so as to afford a constant depth of six feet. The coal is carried in barges averaging about 500 tons, or between 12,000 and 13,000 bushels. Four barges can be easily handled by a tow-boat in the locks, and from 4 to 14 in the open river; while on the Ohio from 14 to 34 barges are taken by a single tug. Thirty barges contain about 15,000 tons, equal to a continuous train of 20-ton railroad cars $5\frac{1}{4}$ miles long. The rate of towing this coal from Charleston, W. Va., to Cincinnati, a distance of 263 miles, is only 25 cents per ton, or, to those who hire barges and so pay rent for them, $37\frac{1}{2}$ cents per ton. To Louisville, 394 miles from Charleston, the rate, including rent, and the return of barges, is 48 cents per ton, or $1\frac{21}{100}$ mills per ton per mile. For the longer distance to New Orleans, 1,776 miles, the cost is $1.25 per ton, or $\frac{1}{14}$ of a cent per ton per mile. Contrast this now with the cost of railroad freight from New York to Chicago, 913 miles, and we have $4.50 per ton, or 5 mills per ton per mile, against $\frac{7}{10}$ of a mill per ton per mile for 1,776 miles to New Orleans. Surely nothing can show more clearly the value of water carriage to the community as a whole, and no better argument could be advanced in favor of the continued development of our river, canal, and lake navigation.

JOSEPH F. JAMES.

Washington, D.C., Dec. 10.

A Manual of Physics. By WILLIAM PEDDIE, D.Sc., F.R.S.E. New York, G. P. Putnam's Sons. 501 p. 8°.

THE language of mathematics is noted for precision and conciseness; but, with its incomparable advantages, both for expression and for reasoning, it offers a barrier to many minds as forbidding as any Chinese wall. One reader of physics enjoys brilliant lecture experiments, another desires a guide to accurate laboratory measurements, but neither phase is apparent in this volume. It is offered as "an introduction to the study of physical science, designed for the use of university students." With little descripti n of apparatus or manipulation, it presents an orderly view of the several topics, setting forth the unity of natural philosophy, and tracing the results of observation to the kinetic

CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

Dec. 20.—Symposium, Is Simplified Spelling Feasible? Discussion by Professor F. A. March of Lafayette College, Hon. A. R. Spofford, Hon. Wm. T Harris, Hon. Edwin Willits. The discussion will be continued Dec. 27 by the remaining speakers.

hypotheses which best explain them. The more important formulas of differential and integral calculus are deduced in an early chapter (of only 15 pages) on "varying quantities." This is well written for review, but less adapted to the student who is unfamiliar with calculus. The next chapter discusses vectors, composition of motion or velocities, harmonic motion, etc., as preliminary to mechanics, gravitation, and the properties of matter. While the phenomena and the laws of sound, light, heat, and electricity are taken up in succession, the essential unity and interdependence of the several subjects are kept in view. Thus many of the terms and formulas which we usually associate with statical electricity are discussed in connection with gravitation.

Among the interesting topics are Thomson's hypothesis of vortex atoms, Maxwell's electro-magnetic theory of light, and the several theories of ether.

References to original papers, and problems to be solved by the student, might have been desirable features, but would have increased the size of the volume. A very large range of physical science is comprised within moderate space; and this is confidently recommended to those who enter into the beauties of mathematical thought. ROBT. B. WARDER.

The Woodworkers' Manual. By C. R. TOMPKINS, M.E. The author, Dover, N.H.

THIS is a pamphlet of sixty pages containing a condensed account of the machinery and processes of woodworking, by an author evidently practically familiar with the subject. He gives a plain and simple account of the best practical methods of planning and building the woodworking "plant" and of placing its machinery. The most usual and standard forms of woodworking machinery are described, and "practical instructions for the care, management, and preservation of the machinery" are given. Illustrations of the tools employed are also given. The paper is printed in good style, and it would be worth while, one would think, to double its extent and bind it up. The good sense of the author is seen in his remarks about the use of lubricants. He thinks that there is "no economy in saving five dollars on the price of a barrel of oil, and losing ten dollars, in consequence of its use, in extra repairs; which is in most cases a fact."

AMONG THE PUBLISHERS.

PROFESSOR E A. SMITH, State Geologist of Alabama, has recently published a "Sketch of the Geology of Alabama." In it are given descriptions of the various geological formations outcropping, with mention of the economic products found in them. In this regard the most valuable rocks are the crystalline schists of Archæan age, and the Coal Measures. From the former are derived many varieties of minerals and from the latter large amounts of coal. The Clinton or Red Mountain formation is also of value for the large quantity of iron ore it contains. The formations occurring in the State and treated of with more or less fullness, are Archæan, Cambrian, Silurian, Devonian, Carboniferous, Cretaceous, Eocene, Miocene, Pliocene (?), Pleistocene, and Recent. The pamphlet will prove useful to geologists in general and the citizens of Alabama in particular.

— Professor Merwin-Marie Snell, who is one of the few specialists in comparative religion to be found in the United States, and who has been known for some years as a writer and lecturer on that and other anthropological subjects, has recently severed his connection with the University at Washington, for the purpose of giving his attention to the conducting of a magazine devoted to the comparative history of religions and the archæology, philology, history, philosophy, religion, and literature of the Asiatic peoples. The leading specialists of Europe and America will be found among the contributors, but it is intended to give the periodical enough of a popular character to make it acceptable to the general reader as well as to the serious students of the sciences concerned. The name of the magazine will be *The Oriental Review*. It will be a bi-monthly, with a subscription price of two dollars a year. The publication office is at 2,128 H Street, N. W., Washington, D. C.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For exchange.—Minerals, fossils, F. W. shells, land shells, native woods, Indian relics, two vols. of Smithsonian reports, odd numbers of scientific magazines, copper cents, etc., for good minerals not in my collection, good arrow- and spear-heads and natural history specimens of all kinds. Correspondence solicited with list of duplicates. G. E. Wells, Manhattan, Kan.

For sale or suitable exchange.—A spectrometer made by Fauth & Co., Washington, D. C., according to the plan of Prof. C. A. Young. This instrument is suitable for the most advanced investigations and determinations. Cost originally $700 and has been used but little. Will be disposed of at a considerable reduction. Address Department of Physics, Ohio University, Athens, O.

I will send British land and fresh-water shells in return for those of America, any part, sent to me. I have at present about fifty or sixty species, with many varieties. W. A. Gain, Tuxford, Newark, England.

The Biological Department of Hamline University desires to offer microscopic slides of animal tissues, or whole animals, in exchange for first-class fossils. Address correspondence to Henry L Osborne, Hamline University, Hamline, Minn.

For sale.—A set of the Berichte der Deutschen Chemischen Gesellscaft, from Jan. 1, 1877, to Jan. 1 1892, bound in twenty-six volumes to Jan. 1, 1888 and remaining four years unbound. Also the Bulletin de la Société Chemique de Paris, from Jan. 1 1879, to Jan. 1, 1892, bound in eighteen volumes to Jan. 1, 1888, and remaining four years unbound. Dr. Marcus Benjamin, care of D. Appleton & Co., 1 Bond St., New York City.

For Sale.—A new Model U. S. Army Hospital Microscope (Zentmayer), also ⅙-inch and 1⅓-inch Objectives. HENRY C. WELLS, 151 Broadway, New York.

Wants.

WANTED.—American Journal of Conchology, seven volumes. Parties having these for sale will please address the undersigned, stating condition and price. R. Ellsworth Call, Louisville, Ky.

A GRADUATE ENGINEER will give instruction evenings in geometry, trigonometry and surveying, mechanics, physics, mechanical drawing and general engineering construction. Five years' experience in field and editorial work on engineering journal. References furnished. C. S. H., 102 Tribune Building, New York.

A POSITION is desired in the South, preferably the Gulf States, where I can teach the sciences. Can also instruct in other branches. Salary only nominal, as I am simply desirous of employment while spending the winter in the South. A private family preferred, but will accept regular school work if not too confining. MORRIS GIBBS, M.D., Kalamazoo, Mich.

WANTED.—By well-qualified and experienced science master and associate of the Royal School of Mines, London, aged 26 (at present in England), a mastership in technical college or university for any of the following subjects: Engineering sciences, geology and mineralogy, physics, chemistry and metallurgy, etc., etc. Can provide excellent references and credentials. Apply, J. G., 17 Sussex St., Rochdale, England.

A GRADUATE of the University of Pennsylvania and a practical mineralogist of twenty years' experience desires to give his services and a cabinet of 25,000 specimens, all named, with about the same number of duplicates, in minerals, crystals, rocks, gems, fossils, shells, archæological and ethnological specimens and woods to any institution desiring a fine outfit for study. The owner will increase the cabinet to 50,000 specimens in two years and will act as curator. Correspondence solicited from any scientific institution. J. W. Hortter, M.D., Ph.D., San Francisco, Cal., General P. O. Delivery.

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PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

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To the Readers of SCIENCE:

During the past year it has been found possible to enlist the interest of scientific workers in the success of *Science* to such an extent that more than eight hundred have promised contributions during the coming twelve months. Not only are contributions of merit coming in ever increasing numbers from American scientific men and women, but we are now securing our first contributions, in any quantity, from abroad.

We know that this development in the usefulness of *Science* is appreciated, not only from the many kind letters received, which are always inspiring and which we wish our friends would mark as at our disposal for publication, but from a marked increase in the number of new subscribers.

Science owes its existence to the munificence of two gentlemen, whose names we do not feel at liberty to publish, who contributed very nearly $100,000 toward the support of the paper in its early years. There is no longer need of such liberal subsidizing, but we do need cash subscriptions from all who feel at all interested in a weekly journal of science in America.

There is no question that scientists are cosmopolites and that a journal is the more useful to them the more it is international in its character. As the result of our efforts to develop the use of *Science* abroad, we have recently published articles from V. Ball, Dublin; Edward T. Dixon, Cambridge, England; A. H. Keane, London; David MacRitchie, Edinburgh; Edward Seler, Berlin; Isaac Taylor, York; G. D. Liveing, Cambridge, England; the Marquis de Nardaillac, Paris; Miss Agnes Crane, Brighton, England; E. Trouessart, Paris; J. Edmund Clark, York; and have in hand for early publication a number of papers from prominent European scientific men.

To develop this international feature of the paper an enlargement to twice its present size will be necessary, and an increase of the price to six dollars.

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Name..

Address.......................................

SCIENCE

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

TENTH YEAR. VOL. XX. No. 505. | OCTOBER 7, 1892. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

CONTENTS.

Entered at the Post-Office of New York, N.Y., as Second-Class Mail Matter.

To the Readers of [redacted]*IENCE:*

During the past year it has been found [redacted]nlist the interest of scientific workers in the success of *Science* to such a[redacted]t more than eight hundred have promised contributions during the comi[redacted]onths. Not only are contributions of merit coming in ever increasing num[redacted]n American scientific men and women, but we are now securing our first contr[redacted]utions, in any quantity, from abroad.

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PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

TENTH YEAR. VOL. XX. No. 506. | OCTOBER 14, 1892. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

CONTENTS.

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SCIE[redacted]E

A WEEKLY NEWSPAPER OF ALL TH[redacted] SCIENCES.

PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

TENTH YEAR. Vol. XX. No. 507. | OCTOBER 21, 1892. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

CONTENTS.

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To the Readers of SCIENCE:

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PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

TENTH YEAR.
VOL. XX. No. 508.

OCTOBER 28, 1892.

SINGLE COPIES, TEN CENTS.
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VOL. XX. No. 509.

NOVEMBER 4, 1892.

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PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

TENTH YEAR. VOL. XX. No. 510. | NOVEMBER 11, 1892. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

CONTENTS.

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PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

TENTH YEAR. VOL. XX. No. 511. | NOVEMBER 18, 1892. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

CONTENTS.

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SCIENCE

Library Leland Stanford Jr. Univ.

TENTH YEAR. VOL. XX. No. 512. | NOVEMBER 25, 1892. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

CONTENTS.

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TO VOLUME XVIII OF
SCIENCE
is in preparation, and will be issued at an early date.

SCIENCE

Tenth Year.
Vol. XX. No. 513.

DECEMBER 2, 1892.

Single Copies, Ten Cents.
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Contents.

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We have stated how much two public-spirited gentlemen have done in the past for *Science*, solely with the desire of having a scientific weekly in this country and without any expectation of pecuniary return. The scientific community in America is small, we know,—only about one-fourth that in Great Britain,—and it will require the assistance of at least *eight hundred* scientific men and women *not now on our subscription lists* to justify our making an enlarged *Science*. Possibly so many new subscribers cannot be obtained promptly from a class of persons who already have large calls upon them for the support of scientific institutions. To make the matter easier, therefore, we do not ask immediate payment.

Kindly give this proposal prompt attention, as there is such an accumulation of MSS. that more than half of them must be returned to the writers before the close of the month if the paper is not to be enlarged.

Form of Subscription.

N. D. C. Hodges, 874 Broadway, New York:

You may enter me as a subscriber to *Science* from January 1, 1893, and I promise to remit six dollars before ...., this being contingent on the size being increased as proposed above.

Name...

Address...

A MINIATURE STEAM-ENGINE.

By the kindness of our correspondent, Mr. Max Kohl of Chemnitz, Germany, we are enabled to present to our readers an illustration of a miniature steam-engine, recently constructed in his establishment. Although so small as to fit easily within its case, composed of an ordinary walnut shell, the little machine is a practical working model, correctly and completely finished in all its parts. The cylinder, which is supplied with a complete sliding valve, is 5.5 mme. in length and has a bore of 2 mme. The boiler is 20 mme. in length and 8.5 mme. in diameter. The diameter of the fly-wheel is 10 mme. and that of the steam channels 0.2 mme. The slide is 1.8 mme. in length and 1.7 mme. in breadth. The machine is furnished with safety-valve, waste-cock and funnel. The model is to be driven with a spirit lamp, but it can also be put in motion by means of a thin rubber tube, the one end of which is to be screwed in the funnel on the kettle, while the other end is supplied with a mouth f r blowing air into the kettle. The model only serves to show in what small dimensions working steam-engines can be made.

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TO VOLUME XVIII OF
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SCIENCE

TENTH YEAR.
VOL. XX. No. 514.

DECEMBER 9, 1892.

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2 Subscribers,	$11	" " " " " "
3 "	$15.75	" " " " " "
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More than four at same rate.

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SCIENCE

TENTH YEAR. VOL. XX. No. 515. | DECEMBER 16, 1892. | SINGLE COPIES, TEN CENTS. $3.50 PER YEAR, IN ADVANCE.

CONTENTS.

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SCIENCE

TENTH YEAR.
VOL. XX. No. 516.

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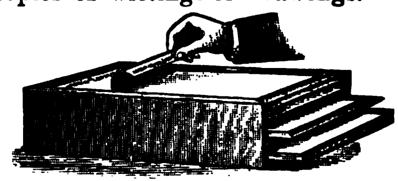

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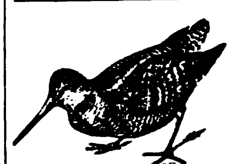

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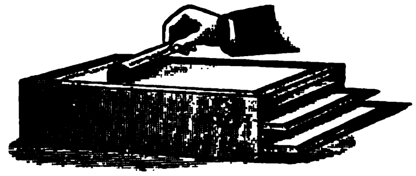

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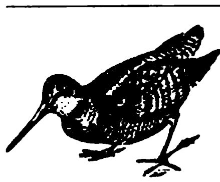

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